RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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GENERAL INFORMATION

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Introduction of the Memorial Fund Lecturer Lee B. Lusted, M.D.

EUGENE P. PENDERGRASS, M.D.

I AM GRATEFUL TO President Robbins and Dr. Walter W. Wasson for the privilege of introducing the Memorial Fund Lecturer on this occasion—Dr. Lee B. Lusted.

Dr. Lusted was born in Mason City, Iowa, on May 22, 1922, the son of a Methodist minister. His early education included exposures in a number of secondary schools before his graduation from the Mason City high school. At Cornell College, Mount Vernon, Iowa, he majored in mathematics and physics, receiving his B.A. degree in 1943. Because of the need of electronic engineers, he then joined the group at the Radio Research Laboratory at Harvard University and worked there for several years (1943–1946). During this period, General Eisenhower requested that some electronic engineers be sent to the European theater of operations to help check the radar countermeasures equipment which would be used in the D-Day landing fleet. As an employee of Harvard University and the Office of Scientific Research and Development, Lee Lusted was one of the group to be sent on this mission, serving for approximately one year with the British Home Fleet and with the 8th Air Force.

During his stay at the Radio Research Laboratory, Lee came in contact with two members of the faculty who were applying various electronic technics in the field of biology. His interest in medicine was thus aroused, and he subsequently attended and in 1950 was graduated from the Harvard Medical School. Having decided to go into Radiology, he served his residency with Dr. Robert S. Stone at the University of California Medical Center in San Francisco.

Lee's main concern is, and always will be, Radiology, but it is quite natural and appropriate that he continue his interest in medical electronics as a hobby. It is not surprising that he is a Fellow of the Institute of Radio Engineers, Editor of the Institute of Radio Engineers Transactions on Medical Electronics, and Chairman of the Committee on the Use of Electronic Computers in Biology and Medicine of the National Academy of Sciences, National Research Council.

Lee's *curriculum vitae* includes a record of honors and a progressive and rapid advancement in academic medicine. At present he is Associate Professor of Radiology at the University of Rochester School of Medicine and Dentistry. His publications include one book, several chapters in other well known books, and more than thirty original articles. Truly, he has attained the stature of a scholar in his area of interest. We in medicine, and in Radiology in particular, point to his achievements with pride.

Mr. President, it has been my good fortune to have known Lee Lusted for a few years and I have watched his pioneering work with interest. It is a heart warming experience to introduce him as the Memorial Fund Lecturer.

Logical Analysis in Roentgen Diagnosis

Memorial Fund Lecture[1]

LEE B. LUSTED, M.D.

DURING THE FIRST year of my residency training I had occasion to ask my chief, Dr. Robert Stone, how I could be sure of the accuracy of my roentgen diagnosis. In the course of our discussion he told me about his former chief, Dr. Howard Ruggles, an excellent diagnostician who was able to make a high percentage of correct diagnoses after a brief examination of the films. Sometimes physicians felt that Dr. Ruggles' ready diagnoses were perhaps not too reliable and they might ask: "Dr. Ruggles, what makes you think this shadow is a metastatic lesion?" To which his just as ready reply would be: "Because it looks like it!" All of us to some extent make diagnoses in this way, and often it is difficult to describe the many possible variations of certain lesions, as, for instance, the protean manifestations of pulmonary tuberculosis.

But what about the traps set for the unwary radiologist who uses this "looks like it" method too freely? Figure 1 shows the lung manifestations of four different diseases. The roentgen findings are similar and few radiologists would make all four diagnoses correctly on the basis of the film alone. However, if I told you that the first patient had carcinoma of the stomach, the second had pneumococci in the sputum, the third had scleroderma, and the fourth appeared acutely ill with dyspnea, cough, and fever, a white blood count of 10,000, and negative sputum culture, you would be much more likely to give the correct diagnoses, namely, for patient 1, lymphatic spread of carcinoma of the stomach;

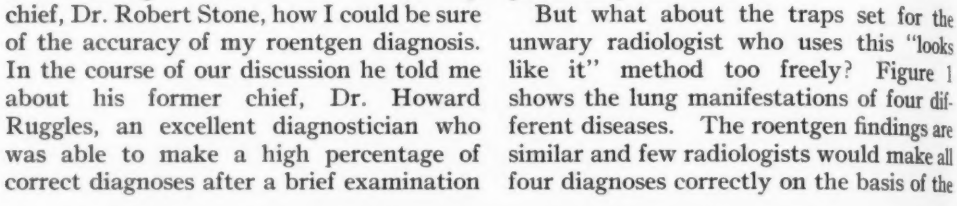

Fig. 1. Pulmonary manifestations of four diseases. Note the similar roentgen appearance of the lung fields; yet Patient 1 has lymphatic spread from carcinoma of the stomach; Patient 2 has disseminated pneumococcal pneumonia; Patient 3 has scleroderma with diffuse pulmonary fibrosis; Patient 4 has a diffuse interstitial pneumonitis of viral etiology.

[1] From the Department of Radiology, University of Rochester School of Medicine and Dentistry, Rochester, N. Y. Presented at the Forty-fifth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 15–20, 1959. This work was supported in part by Research Grant RG-6346 from the Division of General Medical Sciences, National Institutes of Health, Public Health Service.

patient 2, disseminated pneumococcal pneumonia; patient 3, diffuse fibrosis in scleroderma; and patient 4, diffuse interstitial pneumonitis of viral etiology.

Bone lesions are also difficult to describe and identify. Figure 2 is the roentgenogram of the right forearm of a woman who was examined because of her complaint of pain in the arm. An expanding lesion is present in the middle third of the radius. The cortex is intact; there is no periosteal elevation, and a coarse trabecular pattern is present. In this case, if I told you that the patient's left kidney had been removed because of a malignant tumor, you would at once suggest that the bone lesion very likely is a metastatic hypernephroma. Later I will have more to say concerning the description and identification of bone tumors.

It was to problems of identification such as these that Dr. Sosman was referring in his 1950 Shattuck Lecture on *The Specificity and Reliability of Roentgenographic Diagnosis* (1) when he said, "Our diagnoses are based on gross pathology (that is, disturbed morphology) in the great majority of cases—certainly well over 90 per cent. As roentgenologists I am sure that much of our accuracy depends on mathematical probabilities in a given case or set of circumstances." Dr. Sosman realized that the roentgenologist could improve his chances of making a correct diagnosis by considering the pertinent clinical and laboratory findings, and he made extensive use of all available data. But, even when the roentgenologist does make use of clinical data and functional studies, he still may not make a correct interpretation because he does not include all possibilities in his differential diagnosis. The following case history illustrates this point.

A 38-year-old housewife, mother of two children, was seen at the Chest Laboratory, Strong Memorial Hospital, because of dyspnea on exertion for three years, with an increase in severity during the past year. There was no evidence of rheumatic fever from her past history.

When the patient first experienced shortness of breath on exertion, she consulted her family doctor, who told her that she had a heart murmur and placed her on digitalis leaf. His diagnosis was tricuspid stenosis. This medication was continued for one year until the patient had an episode of crushing pain in the anterior left chest. The digitalis was discontinued at that time but was resumed after several months.

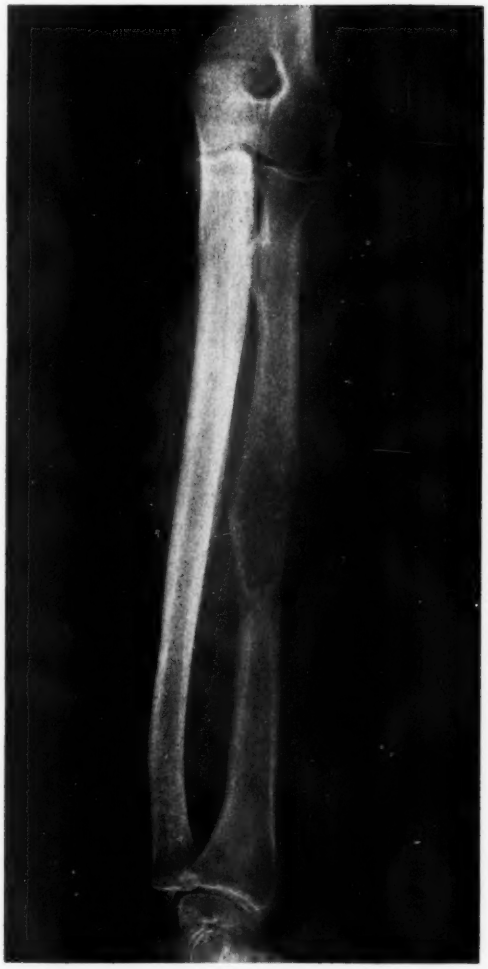

Fig. 2. Bone tumors present the radiologist with a real challenge to improve diagnostic accuracy. This lesion in the radius proved to be metastatic hypernephroma.

Physical examination at Strong Memorial Hospital revealed a blood pressure of 120/80; pulse, 84; respirations, 30. The heart had a normal sinus rhythm and on percussion appeared to be enlarged to the left anterior axillary line. Auscultation revealed P_2 moderately prominent and a Grade II presystolic murmur along the left sternal border and at the apex. The liver edge was palpable four finger breadths below the right costal margin; the

hepatojugular reflex was equivocal, and all peripheral pulses were present and equal bilaterally. There was no edema or cyanosis of the extremities.

The electrocardiogram showed a normal sinus rhythm. P waves were prominent in leads 1 and 2. The complexes were of low voltage throughout, and a QS complex was found in leads V_1 through V_3.

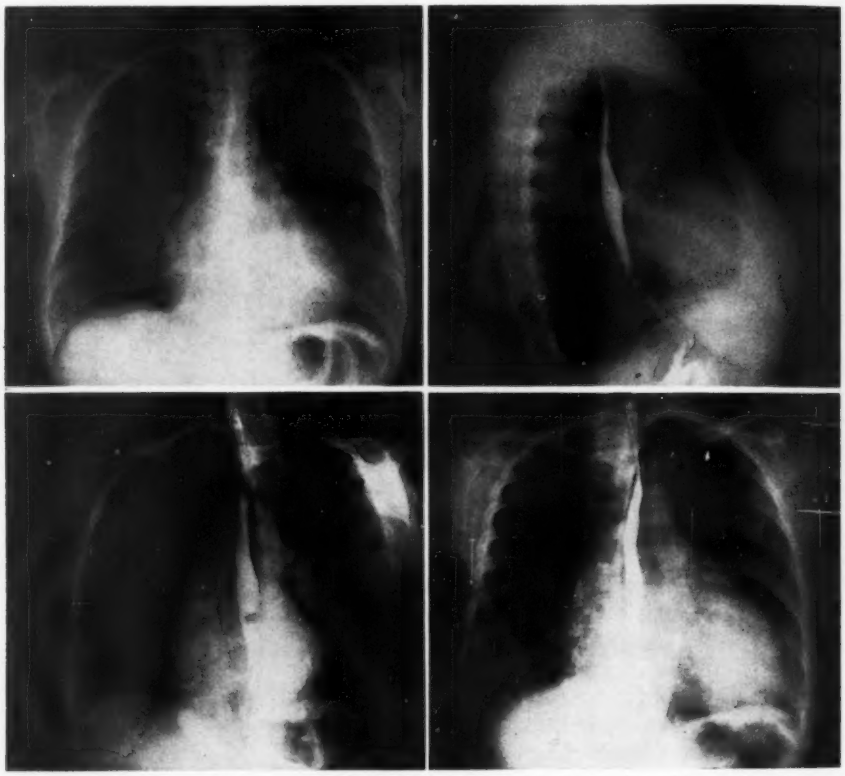

Fig. 3. Four views of the heart in a 38-year-old woman with chest pain and increasing dyspnea on exertion. The films were interpreted as demonstrating left ventricle and right ventricle enlargement with normal lung vascularity. Should a diagnosis of mitral stenosis be considered seriously with these findings? At surgery a left ventricle of normal size and a small left atrium were found, with no evidence of mitral valve disease. See Fig. 4 for what was found.

The heart appeared semivertical and rotated clockwise.

Fluoroscopy and radiography revealed slight enlargement of the heart with normal amplitude of pulsation. Multiple views of the chest with barium-filled esophagus (Fig. 3) demonstrated left ventricle enlargement in the postero-anterior and left anterior oblique positions. In the right anterior oblique view the right ventricle was seen to be enlarged anteriorly. No left atrium enlargement was found, and the pulmonary circulation appeared to be normal. The radiologist concluded from this evidence that he could not make a definite diagnosis.

At this point the cardiologists decided that the patient *probably* had mitral stenosis and *possibly* also tricuspid stenosis, and a cardiac catheterization was scheduled. This procedure showed a diastolic pressure gradient across the tricuspid valve, and the pressure tracings were interpreted as confirming the diagnosis of tricuspid stenosis. Since tricuspid stenosis often is associated with other lesions, the elevation of pulmonary capillary pressure which had been found was interpreted as indicating mitral stenosis.

With a preoperative diagnosis of tricuspid stenosis and mitral stenosis the patient was prepared for surgery. The surgeon was surprised at exploratory cardiotomy to find a left ventricle of normal size and an extremely small left atrium. The pulmonary artery was soft, with no evidence of increased pressure. Because there was no apparent reason for exploring the mitral valve, it was decided to examine the right side of the heart. The right atrium was large and tense and filled with a soft, smooth-walled mass so that it was not possible to palpate the tricuspid valve. The operative impression was *probable* myxoma of the right atrium.

Subsequently a cineangiocardiogram demonstrated filling defects in the right atrium and right ventricle. Our conclusion was tumor implanted on the right wall of the atrium, extending into the right ventricle. Surgical intervention for removal of the tumor confirmed the presence of a myxoma of the right atrial wall (Fig. 4).

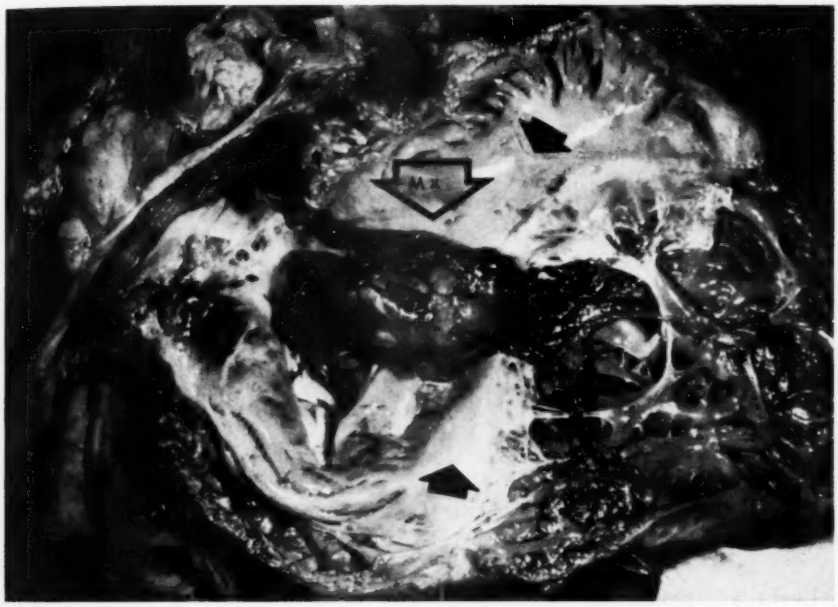

Fig. 4. Surgical exploration of the right heart of the patient shown in Fig. 3 revealed a large and tense right atrium. Within the atrium a mass was palpable. Subsequent examination showed this to be a myxoma (Mx) of the right atrial wall, extending through the tricuspid valve (black arrows) into the right ventricle.

I have presented the details of this case to emphasize two points: first, that we did not put the pieces of the puzzle together correctly and therefore we came to an erroneous conclusion; second, that we did not include all possibilities in the differential diagnosis and therefore did not make the preoperative diagnosis of a rare lesion—a right atrial myxoma.

We should have suspected that something was wrong with our diagnosis of tricuspid stenosis because the right ventricle was too large and the right atrium too small. A consideration of the severity of the symptoms and the elapsed time from the onset of the disease should have accentuated the discrepancy between diagnoses and findings. Tricuspid insufficiency, however, was neither mentioned by the cardiologists nor suspected by the radiologist because of the modest enlargement of the right atrium. Mitral valve disease should have been ruled out because the pulmonary circulation appeared within normal limits and the left atrium was not enlarged.

The logical analysis in this case might have been to consider long-lasting signs and symptoms of pure tricuspid stenosis, nonrheumatic in origin, with an atypical roentgen and fluoroscopic pattern. If we had tried to explain the right atrium in this manner, we should have suspected an intracardiac mass. In fact, the radiologist described the enlargement of the heart cavities as "not consistent with any commonly known heart disease." He forgot the possibility of myxoma.

Dr. Frank L. Campeti has pointed out that up to 1945 not more than 23 cases had been reported in which tumors of the heart were diagnosed during life and that, of

these, only 8 were primary in the heart (2). Only about 150 cases of cardiac myxoma have been described in the world literature (3), but, although the probability of such a lesion is low, it should nevertheless have been included in the differential diagnosis.

Many physicians have commented on such errors of omission in differential diagnosis. Clendening and Hashinger (4), for instance, say: "How to guard against incompleteness I do not know. But I do know that in my judgment, the most brilliant diagnosticians of my acquaintance are the ones who do remember and consider the most possibilities."

At this point I wish to introduce some background material. Several years ago Dr. Ledley and I had some discussions concerning the amount of medical data which is accumulating so rapidly that it seems to impede rather than accelerate medical progress. The student who already has too much material to master and the practicing physician with little time for extensive reading are at the mercy of this avalanche of literature. Could mechanical aids help the medical student and physician? Would a systematic methodology for medical diagnosis assist them in utilizing medical data more efficiently and in reducing the errors of omission? We decided to study both questions. Suggestions for the use of mechanical aids in biology and medicine, *i.e.*, punched cards and electronic computers will be published in book form in 1960. The volume is a result of a study made by Dr. Ledley as principal investigator for the National Research Council Committee on the Use of Computers in Biology and Medicine. Our ideas on the subject of systematic medical diagnosis were published recently in *Science* (5). In this article we tried to analyze the complicated reasoning processes inherent in medical diagnosis and we suggested that the reasoning foundations could be separated from certain intangible judgments which are not susceptible to logical analysis. Further, we suggested that the mathematical disciplines of symbolic logic and probability theory contribute to our understanding of medical diagnosis and that a third mathematical discipline, value theory, may aid the choice of optimum therapy.

One other matter needs to be considered with respect to the subject of systematic medical diagnosis. This has to do with the accuracy of diagnostic procedures—a field of study in which radiology has taken the lead. Wiener (6) points out that "there is a grammar for the semi-exact sciences differing considerably from that which is appropriate in the case of the exact sciences. The errors of observation are part of the observation itself, and any separation between precise observations and errors will lead in the case of the semi-exact sciences to a methodology which actually is less accurate for the results we really desire than a broader, less precise method." All fields of medicine would benefit by studies of observer error similar to the outstanding contributions of Yerushalmy and Garland in radiology. Such studies, by rejecting some of the traditional signs, could lessen the burden we lay upon students of medicine who have to learn so many clinical methods based upon tradition rather than experiment (7).

With this background material we can proceed with the consideration of logical analysis in roentgen diagnosis.

The complete logical analysis of a roentgen examination may be divided into four parts: (*a*) film exposure and processing technics which produce optimum usable information; (*b*) visual physiology of film viewing; (*c*) learning to perceive what we wish to perceive on the films; (*d*) systematic decision-making processes of diagnosis. The first three steps will be discussed briefly in order to point out work which has already been done and some problems which need further investigation.

FILM EXPOSURE AND PROCESSING TECHNICS

For each type of roentgen examination the exposure factors which will produce on a film the maximum amount of information concerning a structure for a minimum roentgen tissue dose need much more study.

In a recent review article Jacobson and Mackay (8) consider this problem. These authors present an excellent discussion of radiological contrast-enhancing methods and give a procedure for selecting kilovoltage and milliampere-second factors. To maximize the image contrast, and thus the amount of information conveyed by the image, an optimum wave length is selected for the thickness of the subject which gives the highest contrast-to-dose ratio. Then an exposure time in milliampere-seconds is chosen which is just sufficient to expose the film. It is interesting to note that electronic control devices could be constructed which would select the milliampere-second factor necessary to put the smallest expected quantum density differences in the subject just above the statistical fluctuations in the quantum distribution (the noise level). Other electronic controls could automatically set up the kilovoltage according to subject thickness measured by the technician, thus producing an automatization of the technic selection aspect of radiographic examination (29, 30).

VISUAL PHYSIOLOGY

After the effort has been made to obtain a film which will afford maximum radiographic information about a structure, it is only reasonable that the film be viewed under conditions which permit the eyes to pick up as much information as possible. Tuddenham (9), in a thorough discussion of this subject, emphasizes the factors which influence the illumination gradient of the retina. He points out that the light of the reader's environment should be at as high a level as possible without glare; that the viewing distance, the use of a diminishing lens for soft-tissue detail and of a magnifying lens for bone detail are important in presenting a preceptible image to the retina. He outlines some problems in selective roentgenography which need further investigation, and the reader would do well to study this paper concomitantly with that by Jacobson and Mackay (8).

PSYCHOLOGICAL FACTORS

Most radiologists will remember at least one or two days during the past year when they just didn't feel like interpreting roentgenograms and perhaps they wondered at the end of those days how many lesions they had overlooked that they might otherwise have noticed. I doubt that any study will ever be made of this matter. Garland (10), however, recently published several examples to illustrate the fact that we tend to notice only those things to which we attribute significance, and I might add that our interpretation of the significance of any event depends to a certain extent on how we feel. Some of the interesting work on the general psychology of perception which is being done by the psychologists should be heeded by radiologists, since they could help test some of the theories being developed. In their paper *Learning to Perceive as We Wish to Perceive*, Murphy and Solley (11) point out that their studies arose from the conviction that man can learn to discover within himself some of the factors which lead to distorted perception, and that, by increasing awareness and control of such distorting factors, he can improve his level of clarity and intellectual honesty. I believe that it is not necessary to discuss this further, but it would be interesting for radiologists to do some research on this subject with respect to film interpretation.

SYSTEMATIC DECISION-MAKING IN ROENTGEN DIAGNOSIS

Accurate roentgen diagnosis, like accurate medical diagnosis, requires first that the data be accurate; second, that the evaluation of the data be thorough and complete; third, that the interpretation of the data be systematic. We have considered the factors which contribute to the first and second aspects and we proceed now to discuss how the radiologist reasons in order to reach a diagnosis.

The reasoning foundations of roentgen diagnosis can be investigated and described in terms of certain mathematical tech-

nics which help separate the logical decision-making aspect of diagnosis from the intangibles and value decisions. Such a separation has important advantages. First, systematization of the reasoning processes helps the radiologist to define the intangibles and therefore enables him to concentrate full attention on the more difficult judgments. Second, since the reasoning processes are susceptible of analysis, errors from this source can be eliminated. Dr. Ledley and I have suggested that the mathematical disciplines, symbolic logic and probability, contribute to our understanding of the reasoning foundations of roentgen diagnosis, while a third mathematical discipline, value theory, can aid the choice of an optimum treatment plan. We believe that these basic concepts are inherent in any medical diagnostic procedure, even when the physician uses them subconsciously or on an "intuitive" level.

The logic concepts inherent in diagnosis emphasize the fundamental importance of considering combinations of symptom complexes in conjunction with combinations of disease complexes. This point is important, since the physician often tries to evaluate a symptom by itself with respect to each possible disease by itself. The logical considerations present alternative disease complexes which the patient can have.

The probabilistic concepts inherent in medical diagnosis arise because a diagnosis can rarely be made with absolute certainty. The end result of the diagnostic process is, rather, a "most probable" diagnosis. Thus the purpose of the probabilistic considerations is to determine which of the alternative disease complexes is "most likely" for a particular patient.

The field of roentgen diagnosis is an excellent testing ground for the logic and probability theories. Already some interesting and important evidence in support of these theories has been supplied by radiologists. I will point out this work as we proceed.

Logical Concepts in Diagnosis: There are three factors involved in the logical analysis of medical diagnosis, namely, medical knowledge, which relates disease complex to symptom complex,[2] the symptom complex presented by the patient, and the final disease complex diagnosis. Each of these three factors can be expressed in terms of symbolic logic as a Boolean function.

If $E\,[S(1), \ldots, S(n), D(1), \ldots, D(m)]$ is the function of medical knowledge relating n symptoms, $S(1), \ldots, S(n)$, to m diseases, $D(1), \ldots, D(m)$, and if $P[S(1), \ldots, S(n)]$ is the function representing the patient's symptoms, then the diagnosis is obtained by finding a function $f[D(1), \ldots, D(m)]$ which satisfies the following fundamental formula: $E \rightarrow (P \rightarrow f)$.

Before a logical analysis model can be demonstrated, it is necessary to review briefly some symbolism associated with the propositional calculus of symbolic logic and the digital notation for this calculus. Suppose that the symbols x, y, ... are used to represent "attributes" or symptoms which the patient may have, such as increased lung vascularity. The corresponding capital letters X, Y, ... are used to represent statements about these attributes. For example, Y represents the sentence "The patient has increased lung vascularity." The negation of this sentence "The patient does *not* have increased lung vascularity" is represented by $\overline{Y}$, where a bar ($^-$) called negation is placed over the Y to indicate "not." Medical statements can be put in logical terms as shown below.

Medical statement: *If* the patient has all pulmonary arteries enlarged *then* he must have increased pulmonary blood flow.
Logic statement: *If* X *then* Y.
Symbolic representation of statement: $X \rightarrow Y$.

Propositional calculus statements such as this can be displayed by a "1, 0" binary digit notation (12, 13). With the digital notation, a model can be constructed which helps to analyze the patients' symptoms

[2] The word *symptom* refers in this paper to all the data about a patient obtained from history, physical examination, roentgen examination, etc.

and the data can be transferred to punched cards or a digital computer.

To demonstrate the elementary computational technic, suppose we assume a simple situation involving two symptoms and two diseases. For this example a logical basis is constructed using binary notation which displays all conceivable combinations of attributes which the patient may have.

For two diseases, $D(1)$ and $D(2)$, the possible combinations are

	d_1	d_2	d_3	d_4
$D(1)$	0	1	0	1
$D(2)$	0	0	1	1

where 0 indicates that the disease does not occur and 1 indicates that it does. Each column, d_1, d_2, d_3, d_4, represents a disease complex. For two symptoms $S(1)$ and $S(2)$, the possible combinations are

	s_1	s_2	s_3	s_4
$S(1)$	0	1	0	1
$S(2)$	0	0	1	1

where each column s_1, s_2, s_3, s_4 represents a symptom complex.

If we consider the four attributes: $S(1)$, $S(2)$, $D(1)$, $D(2)$, then all conceivable combinations of disease and symptom complexes may be written in logical basis form as shown below:

	s_1	s_2	s_3	s_4	s_1	s_2	s_3	s_4	s_1	s_2	s_3	s_4	s_1	s_2	s_3	s_4
$S(1)$	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
$S(2)$	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
$D(1)$	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
$D(2)$	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	d_1				d_2				d_3				d_4			

Although a logical basis lists all conceivable symptom-disease complex combinations, it is obvious that many of these do not occur. Which combinations do occur and which do not is information included in the body of medical knowledge.

The "1, 0" binary digit notation and the logical basis system are directly applicable to roentgen studies. Dr. Gwilym Lodwick has been doing some very interesting work on bone tumor analysis in which he has used a form of digital notation and punch cards. I appreciate his permission to use an example: Figure 5, A shows a roentgenogram of an osteogenic sarcoma. A description of the tumor in profile form is shown in Figure 5, B. It is apparent that the squares formed by the rows and columns resemble a logic basis pattern where each black square equals 1 and each empty square equals 0. The pattern or profile may be given to a person who is familiar with the meaning of the code and from these data he can make a drawing (Fig. 5, C) of the lesion. This person need not be a radiologist nor have medical training in order to reproduce the lesion (32). The requirement is that he understand the code. However, a knowledge of anatomy and drawing skill would be important assets in this test. Dr. Lodwick, using the system himself, reports a diagnostic accuracy varying between 50 and 90 per cent depending on the type of bone cancer (14). In my opinion this is a good batting average. Dr. Lodwick has transferred the bone tumor profile data to punched cards for further study. As long ago as 1954 (15) he stated that machine analysis of the punched card data should reproduce quite accurately the bone lesion description. Further work may show that such a system will enable the radiologist to give a most accurate prognosis of a bone tumor from the roentgenogram.

Description codes are used, of course, in other fields of medicine. One of the most interesting discussions of this subject appears in the article, *Wanted—A Good Cookbook*, by Meehl (16) of the University of Minnesota. I commend it to your attention.

Probability Concepts in Diagnosis: In the preceding section, I showed how the logical basis and digital notation might be used to display a statement such as, "If the patient has coarctation of the aorta,

then he must have rib notching." Such positive statements have a place in considering symptom-disease complexes, but a more accurate statement would be, "If the patient has coarctation of the aorta, there is a certain chance that he will have rib notching." Since "chance" or "probability" are part of medical knowledge, then probability is part of the diagnosis itself. At the present time very few specific symptom probabilities are known; medical textbooks, therefore, do not give numerical values, although they may use words such as "rarely," "very often," "uncommon," etc. The collection of statistics for certain symptom-disease complexes is one of the projects on which Dr. Ledley and I are working. Let us assume, however, that the statistics are available and that the probabilities can be determined, so that we can discuss methods for using probabilities in diagnosis.

Suppose that it is not feasible to make further tests to distinguish between alternative diagnoses. The problem is: Given the symptom complex (s_j), what is the probability that the patient has a particular disease complex (d_i). This statement can be expressed $P(d_i/s_j)$, where the symbol to the right of the slant is the known symptom complex and the symbol to the left is the disease complex whose conditional probability we wish to find.

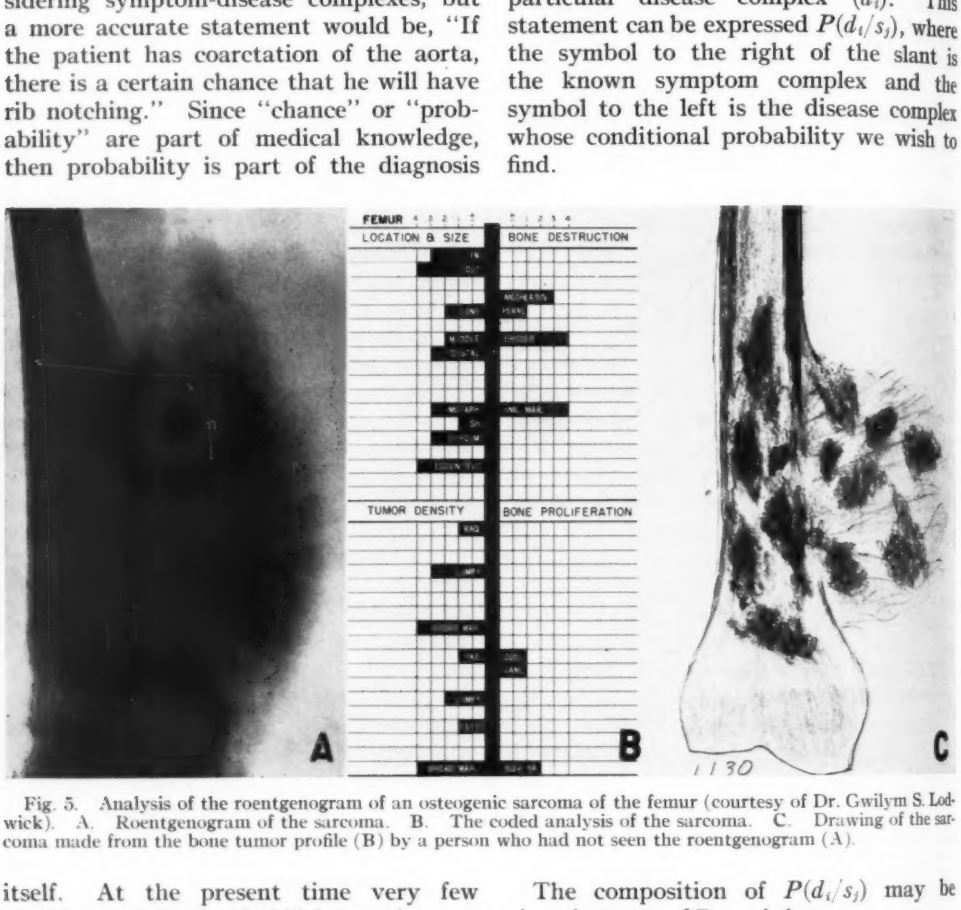

Fig. 5. Analysis of the roentgenogram of an osteogenic sarcoma of the femur (courtesy of Dr. Gwilym S. Lodwick). A. Roentgenogram of the sarcoma. B. The coded analysis of the sarcoma. C. Drawing of the sarcoma made from the bone tumor profile (B) by a person who had not seen the roentgenogram (A).

The composition of $P(d_i/s_j)$ may be given in terms of Bayes' theorem:

$$P(d_i/s_j) = \frac{P(d_i)\ P(s_j/d_i)}{\sum_{all\ k} P(d_k)\ P(s_j/d_k)}$$

This theorem, which gives an "inverse probability," was expressed by the Reverend Thomas Bayes in 1763 and represents a mathematical basis of induction (17, 31).

The term $P(s_j/d_i)$ is the probability of having the symptom complex s_j when it is known that the patient has disease complex d_i. Medical textbooks usually present the disease-symptom information in this sequence. The reason that textbook material is usually discussed in

terms of $P(s_j/d_i)$ rather than $P(d_i/s_j)$ is that the disease gives rise to the symptoms. Therefore, we have assumed that $P(s_j/d_i)$, which represents the symptoms from a particular disease complex, is a constant.

The term $P(d_i)$ is the probability that for a particular population of patients any particular patient in that population will have disease complex d_i. This term manifests the changing influence of geographical, seasonal, and epidemiological factors in the diagnosis.

The denominator $\sum_{all\ k} P(d_k)\ P(s_j/d_k)$ is a normalization factor where *all k* indicates a summation over all possible disease complexes d_k to be considered.

In a previous article (5) we have shown how a conditional probability model for diagnosis can be constructed by using the "1, 0" binary number system in a logical basis.

We have not yet reached the end of the probability considerations, for the reader will realize that each symptom is observed with only a certain degree of accuracy. This means that, before the probability $P(d_i/s_j)$ can be determined, the probability of s_j must be found. In roentgen diagnosis s_j could be, for example, an infiltration in the lung, a solid lung lesion, or a lung cavity. It was apparent to several radiologists some years ago that the variation in s_j affected the accuracy of roentgen diagnosis and they set out to study this variation. The research of Garland, Miller, Zwerling, Chamberlain, Rigler, Newell, and Yerushalmy (18–20) on the accuracy of chest photofluorogram interpretation has been outstanding, and their work has supplied important data with which to develop our concepts of probability in medical diagnosis. I am proud that radiologists have taken the lead in studies on the accuracy of diagnostic procedures and observer error. Garland (10) in a recent article has presented a thorough review of the observer-error problem in radiology and in other medical specialties.

One of the most interesting results of the photofluorogram interpretation study

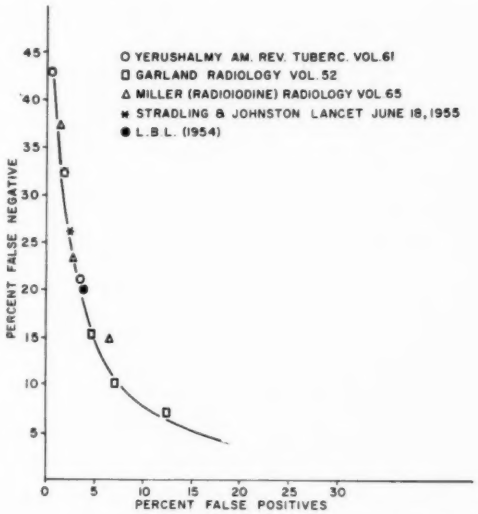

Fig. 6. Graph showing the reciprocal relationship between the percentage of false positive and of false negative readings obtained from studies on the accuracy of chest film interpretation. Miller's study on the interpretation of radiation effect on thyroid gland showed a similar reciprocal relationship.

was the demonstration of the reciprocal relationship between the percentages of false positive and of false negative readings. This relationship is important because it tells us some things about the probable accuracy of the diagnosis. Figure 6 shows the percentage of false positive *versus* the percentage of false negative results from four different studies: three photofluorogram projects (Yerushalmy; Garland; Stradling and Johnston) and a study of radiation effect in the thyroid gland (Miller), which was included because by coincidence the reciprocal relationship curve closely matched the photofluorogram curve. Examination of the curve shows that it is very nearly a hyperbola. Dr. William Horvath (21) has pointed out that this type of curve is found in other screening procedures; for instance, in the detection of malignant cells by Papanicolaou smear. Horvath has shown also that the shape of the curve can be explained by assuming a situation in which the population of both true negatives and true positives is inhomogeneous; and that the two groups overlap with re-

spect to some "sick measure" which is used to define the presence of disease. This "sick measure" is quantitative and continuous, ranging from no detectable sign to one which is very obvious. In screening for carcinoma of the cervix the "measure" could be the percentage of abnormal cells found on Papanicolaou smear or, in screening for pulmonary tuberculosis, the roentgen signs on the chest photofluorogram. The fact is that when we apply a "sick measure" to a group of people we find that the healthy population contains a few individuals whose "sick measure" value is the same or greater than that of a few individuals in the disease population. There is therefore an overlap of the populations at that "measure" value.

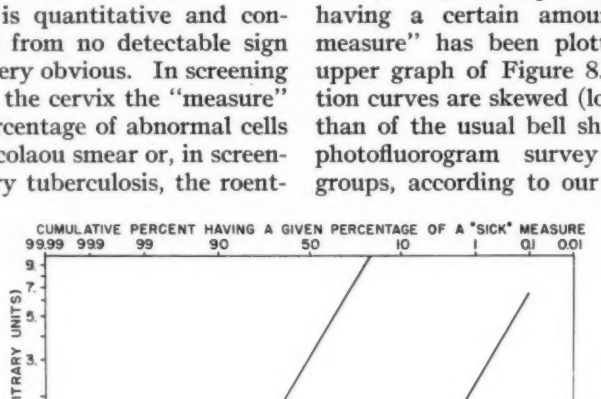

Fig. 7. A population has been divided into two groups, "sick" and "not sick" on the basis of criteria for "sick," which in this case could be the roentgen signs of tuberculosis. The plot is made on logarithmic probability paper.

To demonstrate the validity of such assumptions, we may plot on logarithmic probability paper (Codex Book Company No. 3128) the distribution of two groups of individuals with respect to a "sick" measure which we assume to be the roentgen signs of pulmonary tuberculosis (Fig. 7). It is important to make a log-normal distribution rather than the customary negative exponential distribution because it gives a more faithful representation of the physical processes involved in classifying an inhomogeneous population (22–24). The per cent of each group having a certain amount of the "sick measure" has been plotted in the right upper graph of Figure 8. These population curves are skewed (log normal) rather than of the usual bell shape, and a chest photofluorogram survey of these two groups, according to our "sick measure," would give the reciprocal false positive-false negative relationship shown on the lower left graph in Figure 8. This curve is nearly a hyperbola and matches very well the experimental data curve in Figure 6.

The interpretation of this argument is that, if the "sick measure" criteria have been well chosen, the shape of the curve in Figure 6 is due more to the characteristics present in overlapping populations than to the accuracy of the film readers. Each reader, as long as he looks for the designated "sick measure" criteria, can merely determine where he will operate on the curve and cannot depart from it. Any significant departure from the curve should be investigated. A recent study on the accuracy of radiographic evaluation of pulmonary vasculature illustrates this point. Arnois, Silverman, and Turner

(25) evaluated the conventional chest films of children with congenital cardiovascular disease for increased, normal, and decreased pulmonary vascularity. They found that the rate of errors in determining decreased lung vascularity was approximately 5 2/3 times the rate of errors for increased lung vascularity. As a result of this discrepancy, they concluded that "standards for pulmonary over- and undervascularity as developed in the course of training and experience in radiology are comparable in different levels of radiologic practice and that our test standards were satisfactorily chosen. The analysis does indicate that these standards were appreciably more reliable in this study with respect to the diagnosis of pulmonary overvascularity than with respect to the diagnosis of pulmonary undervascularity (33)."

There is still much work to be done on the use of probability in diagnosis. I hope radiologists will continue to take an active interest in this subject.

Value Theory Concepts: The radiologist is often in close contact with patient treatment problems either as a consultant and "sounding board" for other physicians or as a radiation therapist. For this reason I want to call attention to the possibility of using mathematical "game theory" to help decision making in complicated conflict treatment problems. This is a little-explored field which I hope will appeal to some radiologists. For the reader who is interested in the use of "game theory" in medicine, I have listed several references (5, 17b, 26).

The Application of the Theory: The logic and probability concepts which have been presented may help medical students learn to be more efficient and accurate in medical diagnosis (34). In radiology the concepts, it is hoped, will enable us to decrease observer error and to increase our diagnostic accuracy.

To introduce another use of the theory in roentgenology, I will cite an application in the field of cytology. Several years ago an electronic device called the Cytoanalyzer was constructed by the Department of Biological and Medical Physics at Airborne Instruments Laboratory under the supervision of Mr. Walter Tolles. The purpose of the Cytoanalyzer is to help achieve a high volume of mass screening by submitting Papanicolaou smears to this automatic optical-electronic device. The instrument was designed for separating clearly normal smears from abnormal ones, and it seemed obvious that, if this could be done with reliability and efficiency, then the trained cytology staff would be able to concentrate on the more difficult task of determining the type of cell abnormality rather than on the less challenging function of conventional screening. Preliminary studies showed that cell populations had a lognormal distribution with respect to certain criteria for malignancy (see Fig. 7 again). In addition, interpretation of Papanicolaou smears for the presence of malignant cells by several readers gave a reciprocal false positive-false negative relationship similar to that shown in Figure 8. With the help of the cytologists, the electronic engineers were able to work out five rules of logic for the electronic circuits of the Cytoanalyzer which act as quantitative and descriptive rules for a normal cell. The rules listed below are based on two quantitative var-

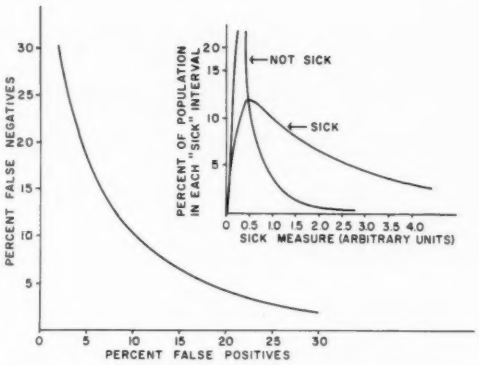

Fig. 8. Upper right graph: The population distribution from Fig. 7 is replotted to show that the distribution curves are skewed (lognormal) rather than the usual bell-shaped normal.

Lower left graph: The reciprocal false positive-false negative relationship for this population is very nearly a hyperbola and is a good fit for the experimental data curve in Fig. 6.

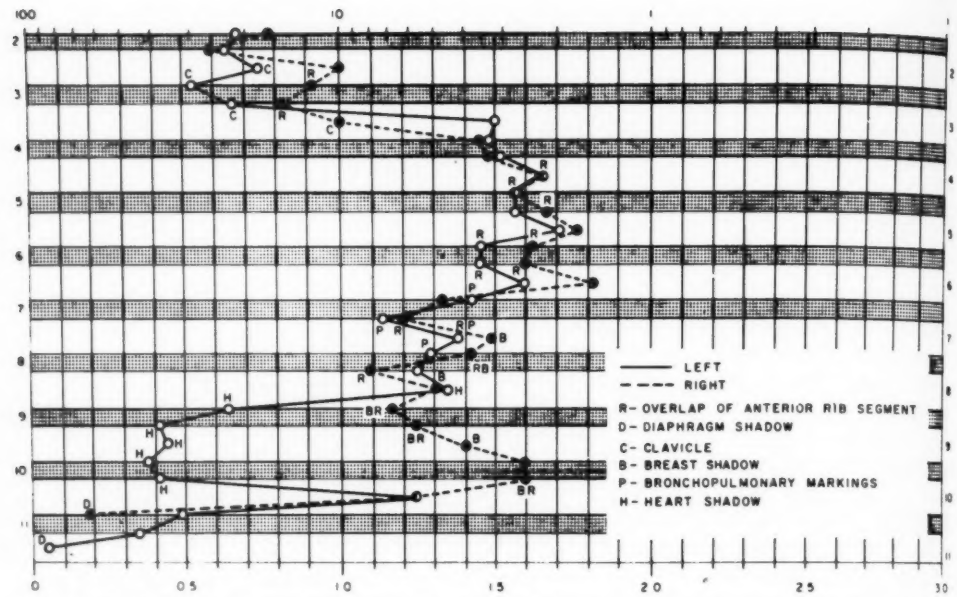

Fig. 9. Vertical density traces from a normal chest photofluorogram. The traces were made to the right and to the left of the midline at approximately the junction of proximal and middle thirds of the clavicle. Notice the difference in the density traces at the level of the ninth and tenth ribs caused by the asymmetrical heart shadow.

iables: the diameter and the amount of light absorbed by the cell nucleus.

1. The nucleus must be less than 20 micra in its major axis.

2. The light absorption by the nucleus must exceed 50 per cent.

3. The contrast between nucleus and cytoplasm must exceed a specified value.

4. The cytoplasm extinction coefficient must not exceed 0.5.

5. Abrupt changes in the shape of the event are cause for rejection.

These rules of logic have worked quite well and, after some experimentation to determine the best operating point on the false positive-false negative curve, the device was put into use in several clinical laboratories. Although tests are still incomplete, results indicate that the electronic operation is quite satisfactory (35).

I think most readers have already anticipated the device which might be developed as the radiologic counterpart of the Cytoanalyzer. It would be, of course, an electronic "scanner-computer" to look at chest photofluorograms and to separate the clearly normal chest films from the abnormal chest films. The abnormal chest films would be marked for later study by the radiologist. The technical problems involved in the construction of a photofluorogram-screening device are much more difficult than those solved for the Cytoanalyzer. However, because of the interest of Dr. Eugene Pendergrass in the possibilities of such a device, Mr. Walter Tolles and his group made some preliminary studies which showed that satisfactory density tracings of a photofluorogram could be obtained by automatic scanning. Figures 9 and 10 show samples of longitudinal and lateral density traces obtained from a chest photofluorogram. With many such density traces it seemed that all of the information could be obtained from the 250,000 picture elements on a 70 × 70-mm. photofluorogram. Unfortunately, at this point the project was discontinued, before the logic and probability problems had received even a preliminary study (27). I hope this project may be resumed, not so much for the photofluorogram-screening device which might be developed but for the study of logic

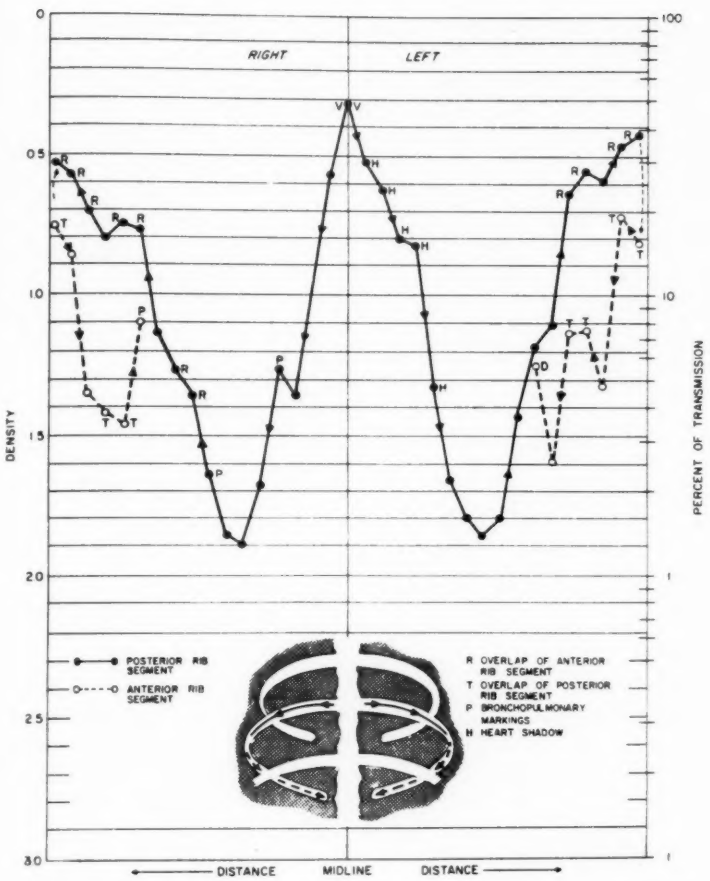

Fig. 10. Lateral density traces from a normal chest photofluorogram. The traces follow the contour of the eighth right and left ribs. Again notice the slight asymmetry caused by the right hilar vessels and the heart shadow.

and probability principles used in chest film interpretation. One of the challenging problems found today in several different fields of science concerns pattern detection and recognition (28): for instance, "reading" a psychometric test profile (16) or a bone tumor analysis profile; or map reading where large surface areas of the earth have been surveyed, as in satellite mapping; or number, letter, and hand writing recognition by a language translating machine. The problems of pattern recognition for a lung lesion are difficult, but the time required to solve them will be well spent. Here is a real challenge for a young radiologist who has a firm grasp of principles in the disciplines of medicine, radiology, and electronics. Who knows? A radiologist could solve the problem of pattern recognition before the space scientists.

CONCLUSION

The amount of medical data accumulating so rapidly today has stimulated an investigation of methods which will enable the physician to use these data more effectively in medical diagnosis.

A better understanding of the reasoning processes concerned with systematic decision-making may help to increase diagnostic accuracy.

We have proposed that there is a part of the reasoning processes which is susceptible to logical analysis and that this part can be investigated and described in terms of certain mathematical disciplines. Symbolic logic and probability contribute to our understanding of the reasoning processes in diagnosis, while value theory can aid our choice of an optimum treatment.

Some studies are cited from the field of roentgen diagnosis which have contributed to a general understanding of the logical analysis processes used in medical diagnosis.

ADDENDUM

Since this article was written, a study has been published (33) on the accuracy of diagnosis in mesenteric small intestinal obstruction. This article showed a range of error comparable to that reported in studies dealing with intrathoracic pathology, detection, and evaluation.

ACKNOWLEDGMENTS: Many people helped with preparation of this lecture. I wish to acknowledge particularly the mathematical contribution of Dr. Robert S. Ledley, with whom I have worked for several years on the subject of logical analysis in diagnosis. Brisk discussions with my colleague, Dr. Frank L. Campeti, have helped me to clarify some of the medical uses of logical analysis. I wish to thank also Dr. William J. Horvath, Dr. Lucy F. Squire, Dr. Herbert J. Koerner, and Mr. Walter E. Tolles for their help.

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SUMMARIO IN INTERLINGUA

Analyse Logic in le Roentgeno-Diagnose

Le massas de information medical, que cresce si rapidemente in nostre dies, ha stimulate un investigation de methodos que permitterea al medico utilisar ille information plus efficacemente in establir diagnoses clinic.

Un meliorate comprension del processos de rationamento interessate in le effectuation systematic de decisiones es possibilemente apte a augmentar le accuratia diagnostic.

Nos assere que le processos de rationamento contine un parte que se presta al analyse logic e que iste parte pote esser investigate e describite intra le terminologia de certe disciplinas mathematic. Logica symbolic e calculo de probabilitate contribue a nostre comprension del processos de rationamento in le diagnose, durante que le theoria de valor pote assister nostre selection del optime tractamento.

Es citate certe studios in le campo del roentgeno-diagnose le quales ha avantiate le comprension general del processos de analyse logic que es usate in le diagnose medical.

Chronic Bronchitis and Emphysema at Bronchography

Survey of Diagnostic Features Obtained by Reviewing 2,000 Bronchograms[1]

ATIS K. FREIMANIS, M.D., and WILLIAM MOLNAR, M.D.

THE INTEREST IN bronchopulmonary diseases is gradually turning from pneumonia and tuberculosis—today amenable to treatment—to conditions such as chronic bronchitis and emphysema, which not only remain challenging therapeutic problems, obscure in etiology, but also seem to be increasing in frequency. That these conditions are of great importance is indicated by the high mortality due to "chronic bronchitis," "pulmonary emphysema," and "cor pulmonale," as shown in countries where these entities are included in mortality statistics. Oswald (24) cites the yearly death rate from "chronic bronchitis" in England as 30,000, a rather astonishing figure, considering that the corresponding annual death rates for pneumonia, cancer, and tuberculosis are 21,000, 16,000, and 8,000, respectively.

Although emphysema is usually recognizable on plain chest roentgenograms, most radiologists are hesitant to make the diagnosis of "chronic bronchitis" from such films. This latter diagnosis is possible on the basis of clear-cut objective bronchographic criteria; yet too little attention has been paid to the wide variety of the diagnostic features. Dilatation of the mucous glands, bronchiolectases, and some other bronchographic characteristics of bronchitis have been described in the American radiological literature. Mention of other findings is scarce. Considerably more information is found in the foreign literature (2, 8, 9, 10, 14, 16, 26, 27, 32, 33, 35). It is the purpose of this paper to draw attention to the manifold bronchographic features of chronic bronchitis and to illustrate these with radiographs selected from 2,000 bronchographic examinations performed in a five-year period by members of the Radiology Department at the Ohio State University Hospital. It is hoped that this study will be a further contribution toward better understanding and earlier recognition of objective roentgenographic criteria of chronic bronchitis.

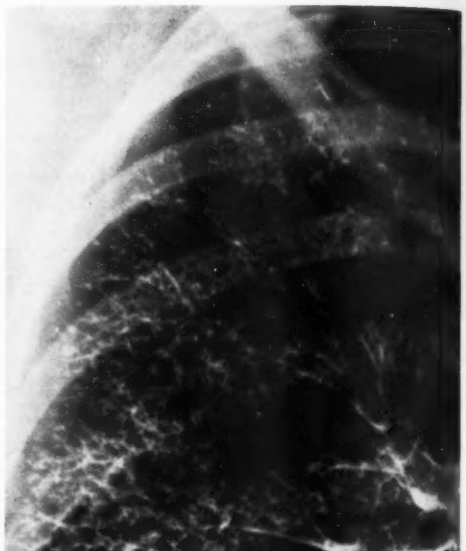


Fig. 1. Bronchogram showing upper lobe area. Note the fine, even peripheral distribution of the contrast material.

BRONCHOGRAPHIC FINDINGS

The bronchographic criteria of chronic bronchitis range from quite minimal functional disturbances to irregularities so extensive and severe that differentiation from early bronchiectasis may be difficult. Quite commonly, a variety of changes, from mild bronchitis to bronchiectasis, will be found simultaneously on bronchograms of one patient. The clinical se-

[1] From the Department of Radiology, The Ohio State University Health Center, Columbus, Ohio. Accepted for publication in February 1959.

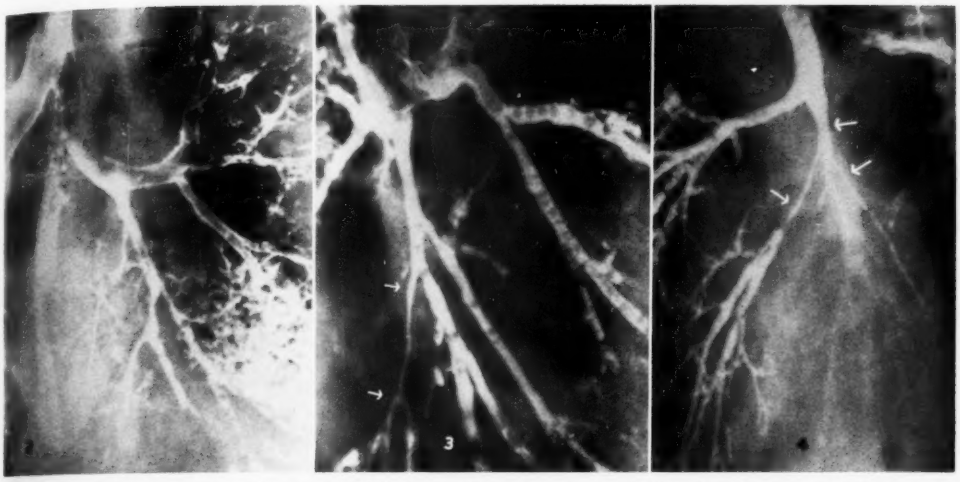


Fig. 2. Generalized spasm of bronchi of left lung. Generally decreased diameter of almost all the bronchi, some areas more constricted than others. Some of the other findings of chronic bronchitis are also present.
Fig. 3. Spasm. Decreased diameter of left lower lobe bronchus and markedly narrowed segmental bronchus in left lower lobe (arrows).
Fig. 4. General spasm of right lower lobe bronchi, except for part of anterior segmental branches. Complete obstruction of posterior basal and lateral basal segments. Note decreased width of bronchus as well. Compare width of spastic bronchi (arrows) with the only mildly narrowed upper lobe bronchus.

verity also varies from mildly symptomatic disease, which is more a nuisance than a threat, to severe disabling states.

The following changes have been observed bronchographically in patients with chronic bronchitis and emphysema:

Spasm, a functional disturbance, is not pathognomonic of chronic bronchitis. It may occur in vegetatively labile persons as an acute response to irritation by contrast material, particularly of the water-soluble type, or it may be caused by the mechanical irritation of the examination. It becomes significant, however, when there is a history of chronic pulmonary disease, evidence of disturbed lung function, or other findings characteristic of chronic bronchitis. Diffuse or localized (lobar or segmental) spasm occurs in asthma, but is not necessarily associated with chronic bronchitis (10, 32, 35, 36). Some authors consider it to be one of the principal factors in the development of both bronchial (bronchial wall destruction, bronchiectasis) and parenchymal (emphysema) disease. During episodes of coughing or forced expiration there is considerable obstruction to the expiratory flow of air through the spastic bronchi. The trapped air is then under increased pressure in the partially closed-off part of the lung or bronchial tree and damage to the bronchial wall or the pulmonary parenchyma and stroma eventually occurs (7).

Narrowing of the bronchial lumen as a result of spasm is seen on the bronchogram. The ends of the spastic segments show a gradual, smoothly tapering transition to normal caliber in contrast to the more abrupt, irregular changes usually found in neoplastic and other organic stenoses. If emphysema is present, the distance between the spastic bronchial branches is increased, as a result of actual increase in volume of the lung. This appearance may be further accentuated by narrowing of the bronchial lumen. The length of the spastic segment is variable. Occasionally, short, localized spastic areas cause local narrowing or obstruction (Fig. 5).

A spastic contraction of a bronchus at its origin is often called "truncular spasm." It is produced by contraction of the obliquely directed elastic and muscular fibers of the bronchial wall, which form loops

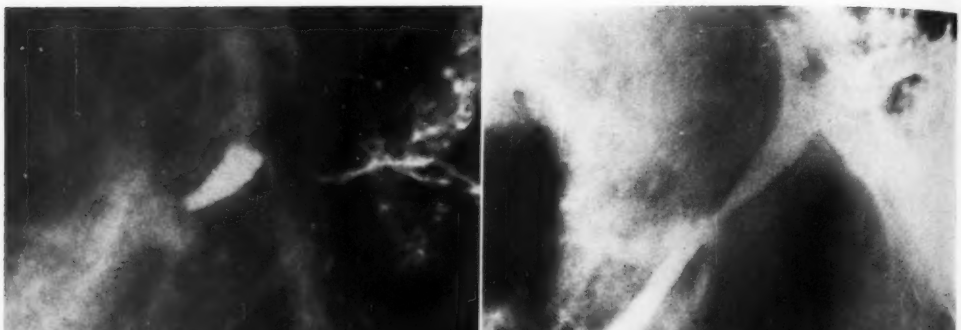


Fig. 5. A. Complete obstruction of right middle lobe bronchus. Carcinoma? Spasm? B. After sublingual administration of Isuprel, the obstruction has disappeared. Note presence of persistent narrowing due to spasm in area just beyond the previously seen obstruction. Peripheral filling is still incomplete. Spasm.

around the bases of the bronchial branches (7, 20). Long spastic segments have a typical, often almost wire- or thread-like appearance. The narrowing of the lumen is often very striking (18) on comparison with adjacent normal bronchi (Figs. 3, 4, 16). The contractions may involve isolated branches, those of part of a lobe, those of one lobe, or all of the branches in one lung (Fig. 2). Occasionally the entire bronchial tree may be involved.

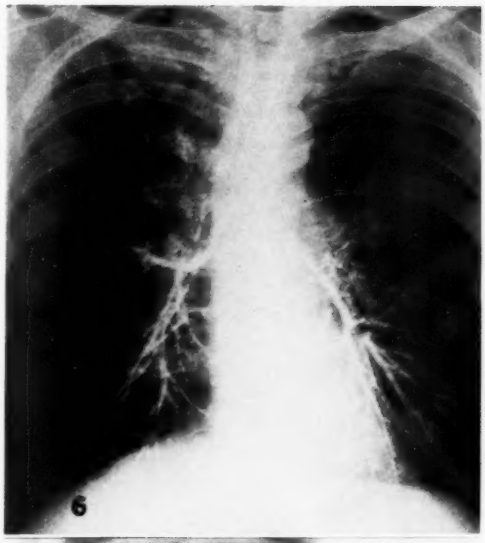
The differentiation of spasm from organic obstruction sometimes presents a problem. The diagnosis of spasm may often be made by observing: (*a*) the general appearance (a long segment may be involved, the narrowed area is often smooth, and the ends are tapered); (*b*) changes in appearance during the examination—a spontaneous change in caliber either during breathing or coughing or after administration of bronchodilator drugs; (*c*) increase in diameter or opening of obstruction on subsequent examination. Examples of the differential diagnostic problems are seen in Figures 3–5.

Emphysema may cause nonfilling of the smaller bronchial branches as a result of stagnation of air in the involved pulmonary segments. Normal aspiration of contrast material, important in producing good filling, is thus precluded. The bronchographic appearance may not be typical and may be difficult to distinguish from nonfilling due to technical reasons, although the presence of marked local emphysema in the area of poor filling may be helpful in differentiation. The bronchogram of the emphysematous patient often exhibits the so-called "leafless tree" appearance, in that there is minimal spread—or none at all—of the contrast material into the alveoli and the terminal branches of the bronchial tree. Other bronchographic characteristics in the emphysematous patient are: separation of the bronchial branches from each other, widening of the peripheral zones into which filled bronchial branches do not extend, bending and displacement of bronchi around emphysematous blebs, and thinning of the peripheral bronchial branches. The emphysema may involve either both lungs in their entirety or only localized areas, which may be either single or multiple (Figs. 6 and 7).

Increased and abnormal secretions are a prominent part of any bronchitic process—whether infectious, chemical, physical, or allergic in origin. Rigler (29) described tenacious, inspissated secretions causing bronchial obstruction in cases of severe or fatal bronchial asthma. Microscopic studies of the bronchial tree in chronic bronchitis show a marked increase in the mucus-secreting elements (particularly the goblet cells), enlargement and dilatation of the bronchial glands, and the presence in the bronchi of exudate often containing microorganisms and pus (27). Secretions may occur in amounts sufficient to fill the lumen of a bronchus, often causing nonfilling of part of the bronchial tree. Their presence is indicated by defects along the bronchial wall, caused by adherent radiolucent secretions, by changes in the location of an apparent obstruction during fluoroscopy or on successive films, and by dilution of water-soluble contrast materials in the cases where these are used (Fig. 8). Delayed films obtained fifteen minutes to an hour after the initial examination may help resolve this problem by demonstrating eventual filling of an initially nonfilled area as the secretions are displaced by or mixed with the contrast material.

It is at times difficult to distinguish globules of secretion suspended in the contrast material from air bubbles. If both are round, differentiation is practically impossible, since air bubbles, though they rise more rapidly, still do not reach the surface fast enough to disappear within a few respiratory cycles. If these "bubbles" in the column of the contrast material are oddly shaped, ill defined, or are seen to persist either fluoroscopically or on several spot films, they should be assumed to represent secretions.

Obstruction (Figs. 4 and 5) of part of the bronchial tree may occur with chronic bronchitis. It may be due to spasm or secretions, as stated above, or it may be caused by destruction of the bronchial wall with subsequent scarring and obliteration of the lumen. The differential diag-



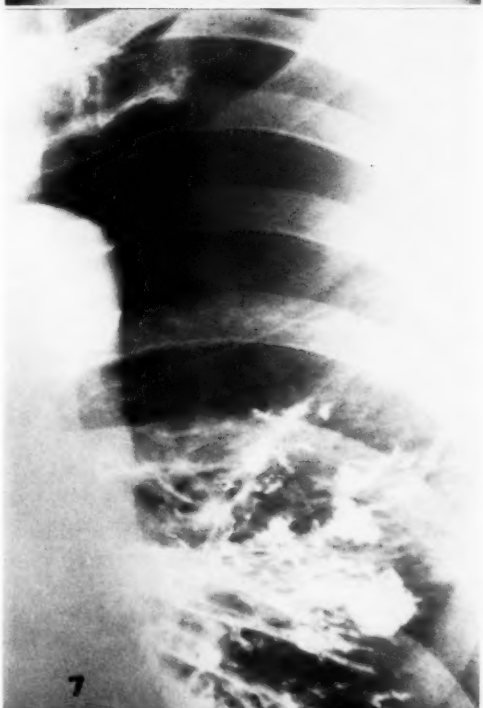


Fig. 6. Diffuse emphysema. The narrowed bronchial segments terminate early, leaving the peripheral lung fields free of demonstrable bronchial branches. A chronic infiltrate is present in the right upper lobe.

Fig. 7. Large emphysematous bulla in left upper lobe. Displacement and crowding of bronchi, irregular peripheral filling and irregularity of contour in several areas.

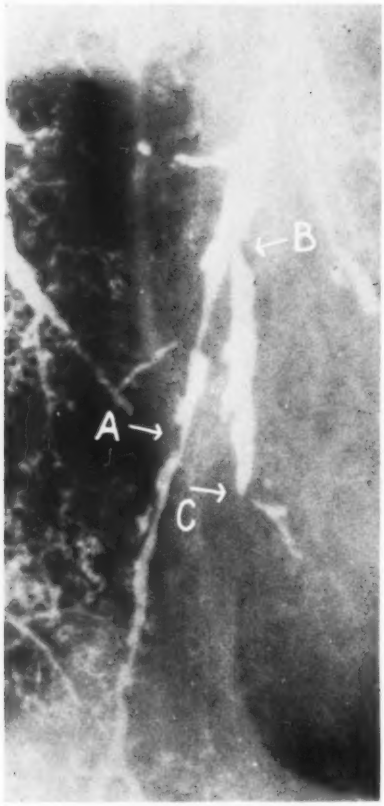


Fig. 8. Highly irregular contour of bronchi in left posterior basal segment, due to adherent secretions (A). Also truncular spasm (B) and obstruction due to solid filling of bronchi with secretions (C).

nosis between nonspecific inflammatory obstruction and neoplastic or specific inflammatory obstruction (*e.g.*, tuberculosis) is difficult, and usually has to be made on the basis of secondary evidence, *i.e.*, the presence or absence of chronic inflammatory changes in adjacent bronchi, enlarged and possibly calcified lymph nodes, identifiable masses encroaching upon the bronchi, or the presence of adjacent infiltrates.

Nonfilling in itself is not necessarily an indication of pathological change; it can be caused by such technical factors as improper positioning of the patient, an inadequate amount of injected contrast material, or insufficient filling time. If nonfilling is due to the latter causes,

Fig. 9. Non-filling of peripheral parts of subsegmental branches of right middle lobe (arrows). Rectangular cut-off of contrast material. Note smoothly outlined bronchi without evidence of bronchitis. Contrast material only coats most of these bronchi instead of filling them solidly. Reason: Insufficient amount of contrast material to provide complete peripheral filling.

the contrast-material coating of the bronchus often shows a sharp rectangular cut-off without demonstrable change in the bronchial wall (Fig. 9). At fluoroscopy, nonfilling due to inadequate injection or faulty positioning may be suspected if there is a back-and-forth movement of the contrast material column with respiration, since an organic obstruction remains stationary.

Patchy alveolization is due chiefly to obstruction or different rates of air flow in the smaller branches of the bronchial tree. Such obstruction may be caused by spasm or secretions but is often due to destruction of the bronchioles with resulting obliteration of the lumen. Areas of emphysema may produce enough delay of air flow to produce irregular peripheral filling.

During bronchography the contrast material normally proceeds evenly into the segmental bronchi, their branches, and eventually the bronchioles, so that, with adequate filling of the bronchial tree a

rather well distributed pattern results. The bronchi are well defined, smooth, and evenly tapering. Their peripheral branches are evenly distributed, and the entire lung field, or at least the entire segment, shows the same pattern (Fig. 1).

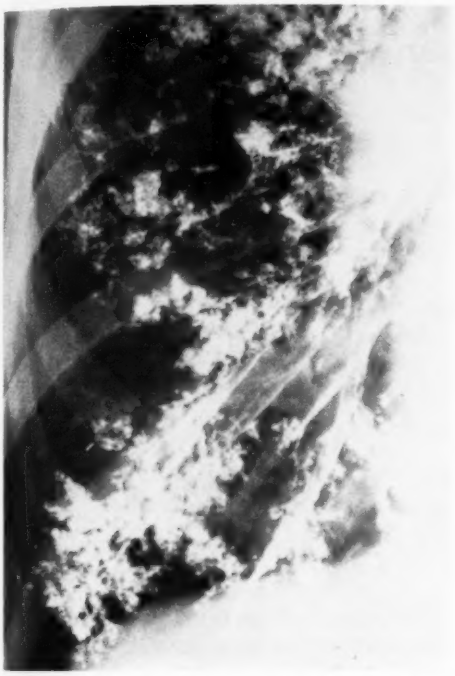


Fig. 10. Moderately pronounced patchy alveolization. Notice relatively large unfilled areas and grouping of filled areas around certain bronchi only.

Irregular peripheral filling can range from relatively mild unevenness (Fig. 10) to a striking major "patchiness" of filled peripheral bronchioles and confluent alveolar filling with large surrounding areas devoid of any contrast material (Fig. 11) (18). It is obvious that in these cases some of the smaller bronchi and bronchioles are functionally or organically obstructed. This appearance has been called the "tattered tree" pattern (22). We prefer to designate the phenomenon "patchy alveolization." Lynne Reid has studied some of these small obstructions histologically (26, 27).

Bronchiolectasis is the result of localized destruction of bronchioles. It is commonly seen in association with patchy alveolization and presents, at first glance, a somewhat similar overall appearance. The "pools" or "bronchiolectases," as they have been designated (4, 26, 32, 37, 38), appear on the bronchogram as rounded collections of contrast material, 2 to 6 mm. in diameter. They may either fill solidly (Fig. 12) or be outlined by a thin layer of contrast material (Fig. 13) with an appearance of a leafless tree with fruit hanging from the branches. The bronchiole itself usually does not continue beyond the pool; however, other bronchioles may extend farther out to the periphery. Lynne Reid has shown these pools to be due to localized suppurative destruction of a bronchiole, with localized dilatation and obstruction of the lumen distal to the pool. Occasionally, particularly in pneumoconioses, there is cylindrical dilatation of respiratory bronchioles (2–4, 15, 18, 25, 31, 38).

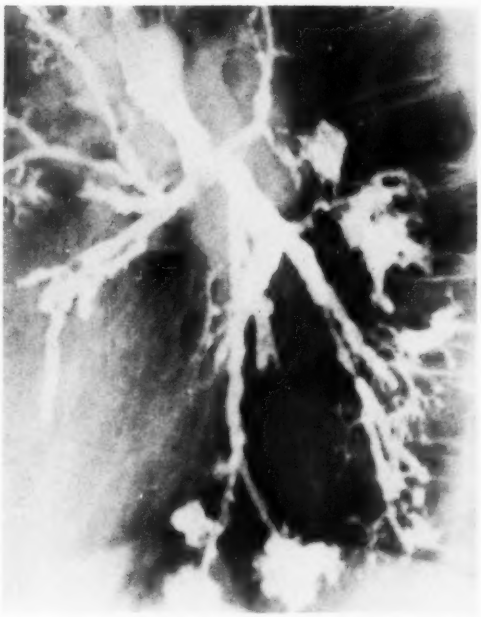
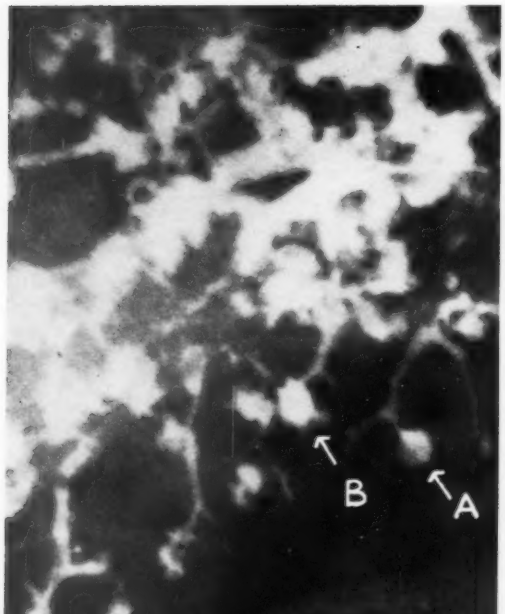


Fig. 11. Example of extreme patchy alveolization. Only a few large patches are filled. Evidence of severe bronchitis as indicated by presence of spasm, secretions, deformity of bronchial wall, and suggestion of bronchiectasis in some areas. Patient also had bronchogenic carcinoma of right upper lobe. (Area shown on this illustration includes the right middle and lower lobes.)

"Spiders," possibly better called "peripheral shadows with spiked outline" (26),



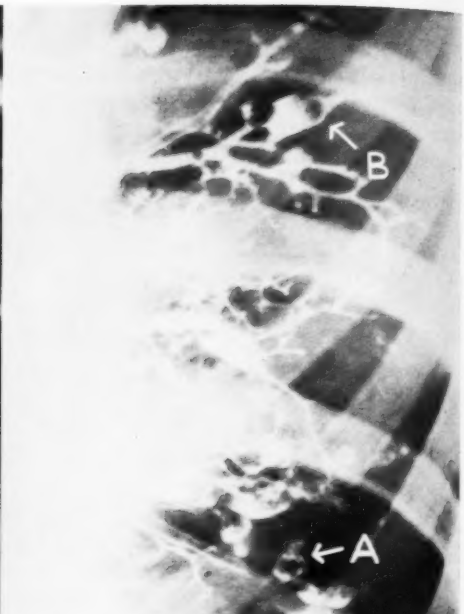


Fig. 12. "Pools" (A) and "spiders" (B) in right upper lobe. Enlarged.
Fig. 13. Combination of "pooling" (A), incompletely filled, and unusual type of bronchiectasis (B). The dilatation involves only a short segment.

are in origin quite similar to the "pools" just described. Both are commonly found on the same bronchogram. The "spiders" represent filled dilated bronchioles with several distended side branches and without further peripheral bronchiolar filling. The appearance is said to remind one of a spider: the central collection being the body, the "spiked" branches the legs. The number of the "legs" varies, and they may be found either on both sides or on only one side of the central collection of contrast material (Fig. 12) (26).

Irregularity and deformity of the bronchial wall due to destruction occur in the more severe cases of chronic bronchitis. Initially the suppurative and destructive process may cause only irregularity of the bronchial outline. Later the contour may become grossly deformed (Fig. 14), bizarre deformities being intermixed with apparently bronchiectatic areas (10, 32, 35, 36). These deformities are due to localized mucosal destruction, localized dilatation of the bronchial lumen, and fibrotic contractions.

Dilatation of the larger bronchi would, by definition, be bronchiectasis. Remarkable localized dilatations of some of the terminal branches may, however, be found in association with chronic bronchitis (Figs. 13 and 14). This type of dilatation has already passed beyond the limits of true bronchitis and represents an unusual type of bronchiectasis. The border line between the more severe changes of the two conditions is poorly defined indeed, and even with experience differentiation is at times difficult. This problem is important, since some cases of bronchiectasis are reversible, while some localized lesions may be treated surgically. Severe bronchitic changes are at times also reversible, but surgical treatment is generally not indicated for chronic bronchitis.

Atrophy of the bronchial mucosa is

manifested by the appearance of annular areas of slight widening and narrowing of the lumen, the image being similar in appearance to the trachea with its rings (Fig. 15) (35). These annular shadows are said to be the result of increased prominence of the cartilaginous rings in the bronchial wall, this in turn being due to the atrophic thinning of the mucosa. This explanation may be valid only for the larger bronchial branches, since the cartilages are ring-shaped solely in the extrapulmonary bronchial tree. The walls of the intrapulmonary bronchial branches contain only irregular bits of cartilage. A similar appearance in the smaller bronchi may be due to prominent circular smooth-muscle bundles. Atrophy in its milder forms is encountered quite frequently, but the severe type is only an occasional finding.

A very commonly made observation is the presence of *mucous gland dilatations*. These dilatations have been described and their nature clarified and proved by several authors (3, 8, 9, 16, 35, 36). Anatomically the mucous glands are found in the groove between the membranous and cartilaginous portions of the bronchial wall. They lie in the depth of the submucosa, in the membranous layer, and even extend to the peribronchial fat. They are not found in the bronchioles. The ducts of some of these glands run through the muscular layer and then turn sideways under the mucous membrane, running almost parallel to it. It is thought that this arrangement facilitates the development of obstruction and subsequent dilatation. If the obstructive plug is expelled, the dilated gland can be filled with contrast material. The distended mucous glands are usually seen as small extensions of contrast medium beyond the lumen of the bronchus, usually on the inferior side (Fig. 16). Most often they are observed in the walls of the major bronchi, and may, at times, become confluent. Their presence on bronchograms is characteristic of chronic bronchitis. However, they are not seen in every case of chronic bronchitis; their demonstration is only another detail in the complex radiographic picture of this disease.

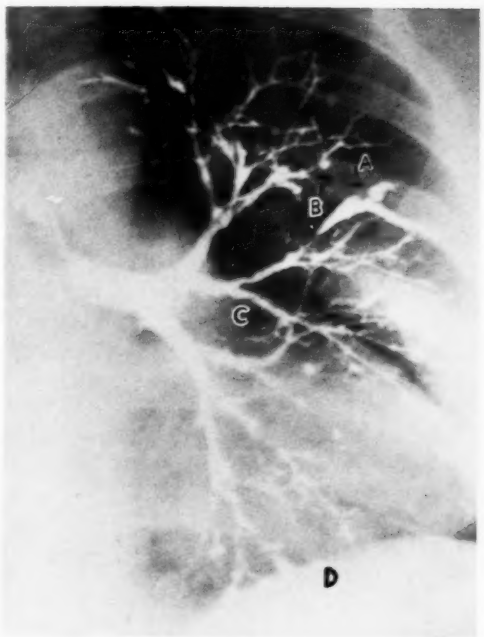
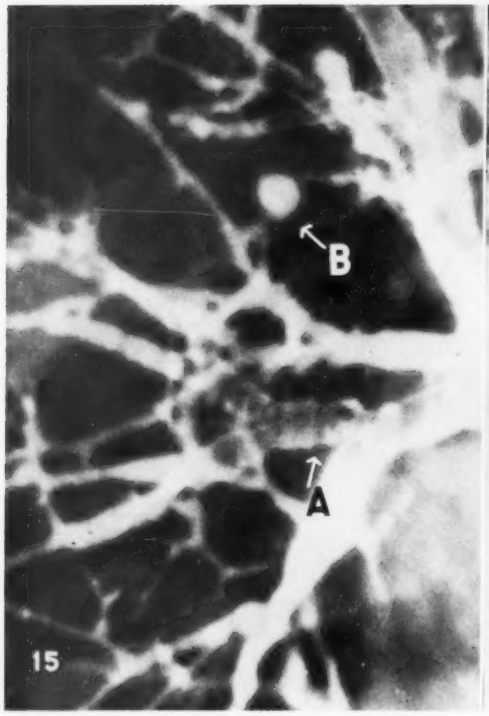


Fig. 14. Localized, unusual peripheral bronchiectasis (A) associated with spasticity of the bronchial tree; a small pool or bronchial diverticulum (B); irregularity of the bronchial wall (C); mild bronchiectatic changes in the basal segments (D).

To complete the discussion of the changes associated with chronic bronchitis, *bronchial and tracheal inflammatory diverticula* should be considered, even though they are not necessarily secondary to chronic bronchitis and may actually in certain instances be the cause of it. We have had the opportunity of observing several cases of single or multiple diverticula, approximately 4–15 mm. in diameter, arising from the bronchi (Fig. 17). Whether these are actually due to bronchitis or to developmental errors is difficult to determine. Several branches of the bronchial tree in the case illustrated in Figure 17 show evidence of chronic bronchitis, possibly supporting the inflammatory theory. It is our impression that "spiders," "pools," bronchiolectases, inflammatory diverticula, and some small peripheral bronchiectases are different types and stages of the same process—suppurative destruction of the



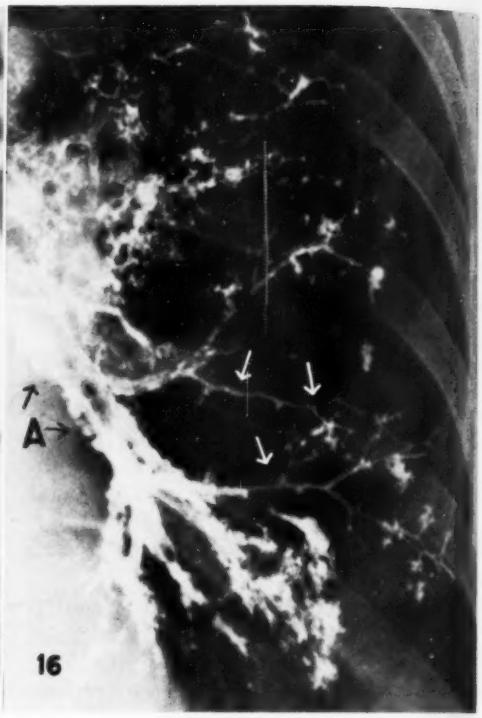


Fig. 15. Atrophy of bronchial mucosa suggesting cartilaginous rings or smooth muscle bundles, more prominent than usual. Note the ring-like radiolucent areas (A) and diverticulum (B).
Fig. 16. Dilated mucous glands along lower surface of left lower lobe bronchus (A). Also note the irregularities of peripheral distribution of contrast material. Marked bronchial spasm is present. Note narrow bronchi (white arrows).

smaller branches of the bronchial tree with subsequent formation of small cavitations communicating with the bronchi.

Rarely, multiple diverticula of the trachea are found. A typical case is illustrated in Figure 18. These diverticula characteristically arise from the junction of the cartilaginous and membranous parts of the trachea and are multiple. Opinions on their nature differ. Some authors regard them as secondary to chronic bronchitis, arising from the mucous glands or developing in weak areas of the trachea due to increased pressure during coughing. By others the bronchitis is believed to be secondary to the impaired bronchial and tracheal drainage. Even histologic examination is not too helpful, since inflammatory elements are always present. A few cases have been found in children, but the number is insufficient to permit a definite statement as to the congenital origin of these interesting lesions. In view of the frequent occurrence of bronchitis and the rarity of tracheal diverticulosis, one has to presume either a congenital weakness of the trachea or a developmental origin.

Single diverticula of the trachea or major bronchi are found more commonly. These are characterized by their typical location and are usually the result of a developmental error in the branching of the bronchial tree, *i.e.*, incomplete formation of one of the branches, which is either supernumerary or displaced. They are clearly not the result of an inflammatory process.

DISCUSSION

On perusal of the literature, it is interesting to note the obvious disagreement re-

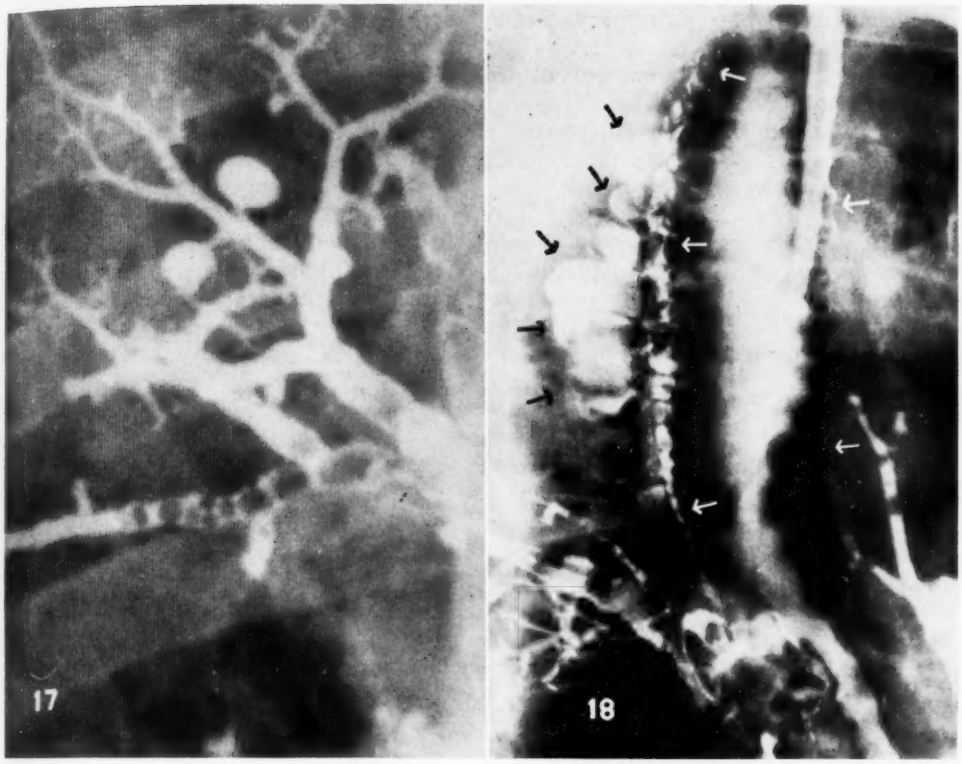


Fig. 17. Two well outlined bronchial diverticula in right upper lobe.
Fig. 18. Tracheal diverticulosis. White arrows: wall of trachea. Black arrows: diverticula.

garding the nature of chronic bronchitis and emphysema (3, 12, 15, 19, 21, 28, 31). Some authors state that bronchitis and emphysema are not usually causally related. Others consider chronic bronchitis, infectious or otherwise, to be a cause of pulmonary emphysema through the mechanism of progressively descending bronchitis, with ultimate bronchiolitis and chronic respiratory obstruction. Other pathogenetic concepts include: "bronchopulmonary disease," vascular spasm (1), vascular degeneration (6), and tiny atelectases with localized compensatory emphysema (11, 13).

The as yet incompletely defined complex of "bronchopulmonary diseases" is thought to involve the functions of the alveoli and bronchioles, with secondary development of bronchitis. The bronchitis is considered to be of little causal significance, but, together with pneumonia, it results in exhaustion of pulmonary reserve with respiratory failure and sometimes death. The etiological agents of this syndrome are thought to be manifold, including among others infection, allergy, dust, and chemical irritants (19, 28).

Several authors (5, 6) have postulated vascular degeneration as a cause of pulmonary emphysema. The degenerative process in the bronchial arteries (which are branches of the aorta and thus part of the systemic circulation) results in thromboses and obliteration of these vessels. This is followed in turn by thrombosis of the branches of the pulmonary artery (pulmonary circulation). Various circulatory abnormalities such as obstruction of the vessels and shunting of blood between the bronchial and pulmonary artery system develop (6, 30). Associated degenera-

tive changes in the pulmonary parenchyma and also in the elastic network of the lungs then occur, with consequent disturbances in bronchial function.

The resolution of these differences of opinion is difficult, since the processes do not lend themselves well to histologic examination. They are chronic in nature and in the early stages are too mild to warrant biopsy or even to cause symptoms. Any information about these conditions during the lifetime of the patient is of value, therefore, in elucidating their nature and furthering means of their prevention and treatment.

The pathologic findings obtained *in vivo* during bronchography are evidence of functional as well as morphologic changes. They may provide the observer with the detailed information necessary for accurate diagnosis and better understanding of the underlying disease process.

While bronchoscopy permits the direct inspection of the mucosa and enables one to obtain biopsy specimens, the extent of visualization is limited to the trachea, the main stem bronchi, and the lower lobe bronchi proximal to their division into segmental branches. Access to the upper and middle lobe bronchi is very limited. Bronchography, however, outlines the bronchial tree almost completely, including the segmental and even the terminal branches, thus yielding valuable information about an extensive part not accessible to other examinations. This explains the increasingly frequent application of bronchography in the detection and differentiation of various pulmonary diseases. The very decision "to operate or not to operate" for bronchial or pulmonary diseases often depends on the bronchogram.

SUMMARY

The radiological findings on bronchograms of patients with chronic bronchitis and emphysema are described.

Chronic bronchitis produces numerous abnormalities which include spasm, abnormal secretions, deformity of the bronchial wall, dilatation of the mucous glands, atrophy of the mucosa, bronchial obstruction, incomplete or irregular peripheral filling, abnormalities in the smaller bronchial branches ("pools," "spiders," and "bronchiolectases"), and inflammatory diverticula.

The wide range of the pathological changes in this entity and their importance in the understanding of chronic bronchitis and emphysema are emphasized. The possible etiologic factors are discussed.

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SUMMARIO IN INTERLINGUA

Bronchitis Chronic e Emphysema in Bronchographia

Es signalate le multiple aspectos radiographic de bronchitis chronic.

Inter le numerose anormalitates demonstrate bronchographicamente es spasmo, augmento e anormalitate de secretion, obstruction bronchial, irregularitate e deformitate del pariete bronchial; alveolisation maculate, dilatation del glandulas mucose, atrophia del tunica mucose, bronchiolectasis con replenation peripheric incomplete o irregular, anormalitates in plus micre brancas bronchial ("stagnos," "nevos stellar," e "bronchiolectases"), e diverticulos inflammatori.

Durante que le bronchoscopia permitte le inspection directe del tunica mucose e le obtention de specimens bioptic, le extension del visualisation es restringite al trachea, le major truncos bronchial, e le bronchos de lobo inferior usque al area de lor division in plure brancas segmental. Le bronchographia, del altere latere, delinea le arbore bronchial quasi completemente, incluse le brancas segmental e mesmo terminal. Le decision de si o non un intervention chirurgic debe esser considerate como indicate depende frequentemente del constatationes bronchographic.

Orbital Hypotelorism, Arhinencephaly, and Trigonocephaly[1]

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ROENTGENOGRAPHIC examination of the skull in frontal projection provides, among other information, an opportunity to evaluate the distance between the orbits. An increased interorbital distance is a characteristic feature of *ocular hypertelorism* or Greig's disease (8). A decrease in this cranial dimension, which properly may be termed *orbital hypotelorism*, is found in *arhinencephaly* and in *trigonocephaly*.

In this paper, the normal range of the interorbital distance in infants and children, as determined in a series of skull roentgenograms, will be presented, and two illustrative instances of orbital hypotelorism will be reported: the first patient was affected by arhinencephaly, the second by simple trigonocephaly. The subjects of orbital hypotelorism, arhinencephaly, and trigonocephaly and the relations which exist among these three malformations will be reviewed.

CASE REPORTS

CASE I (Fig. 1): A white female infant was admitted to the hospital at two and a half months of age for repair of "harelip and cleft palate." She was born at term following a normal pregnancy and delivery. The father and mother were in good health; their ages were thirty-nine and forty years, respectively. The mother had had two other apparently normal children by a previous husband.

At birth, the patient weighed 3,150 gm.; her head circumference was 28.5 cm. (normal, 34.6 cm.). During the first two months of life, she had two left-sided convulsions and showed nystagmus and some spasticity of the extremities. On admission, the child weighed 4,200 gm. and the circumference of her head was 34.5 cm. (normal, 40.6 cm.). The epicanthal folds were prominent and there was a mongoloid slant of the palpebral fissures. The eyes were close-set, bulged slightly, and showed a bilateral nystagmus. The forehead was well shaped. The nose and nasal bridge were flat. The nasal bones and the nasal septum were absent. In the upper lip, there was a mid-line cleft which extended into the single nasal opening (absent philtrum). A bony defect, 0.5 cm. in width, was present in the mid-portion of the superior alveolar ridge (absent premaxilla). The palate was normal. The tongue was thought to be enlarged. The extremities were somewhat spastic, but the patient moved them freely. The rest of the physical examination was not remarkable.

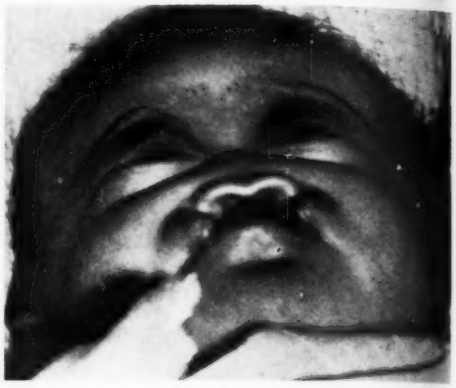

FIG. 1. Case I. Photograph of the patient at three months (courtesy of Dr. J. J. Longacre). The palpebral fissures have a mongoloid slant and the eyes are close-set. Note absence of the nasal philtrum and of the nasal septum.

Roentgenograms of the skull, taken at eight days of age (Fig. 2), showed a small frontal bone and a small anterior cranial fossa. The roofs of the orbits were high in position. The metopic suture and the other cranial sutures were open in their entirety and normal in width. The interorbital distance was markedly reduced (0.55 cm.); this finding was more pronounced radiographically than clinically.

A first-stage operation for the defect in the upper lip was undertaken at three months of age. From that time on, the patient's course was consistently downhill to death, which occurred two weeks later. The course was characterized at first by convulsions, then dehydration, hyperpyrexia, periods of apnea, shock, gastrointestinal hemorrhages, and finally aspiration pneumonia.

In addition to the above mentioned abnormalities, the postmortem examination revealed the following findings: The lamina cribrosa of the ethmoid and the crista galli were absent; the two horizontal parts of the frontal bone were close-set; the ol-

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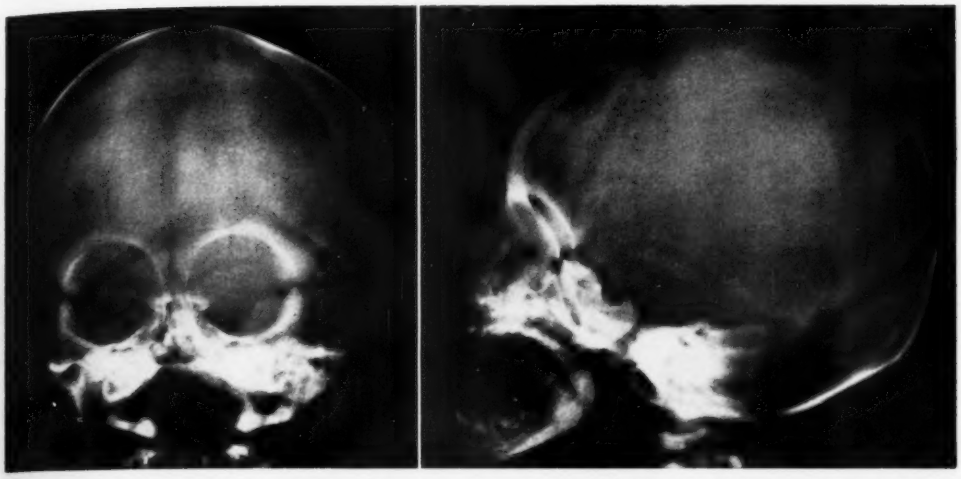

Fig. 2. Case I. Anteroposterior and lateral roentgenograms of the skull taken at eight days of age. Note the narrow interorbital distance, the smallness of the anterior cranial fossa, and the open metopic suture.

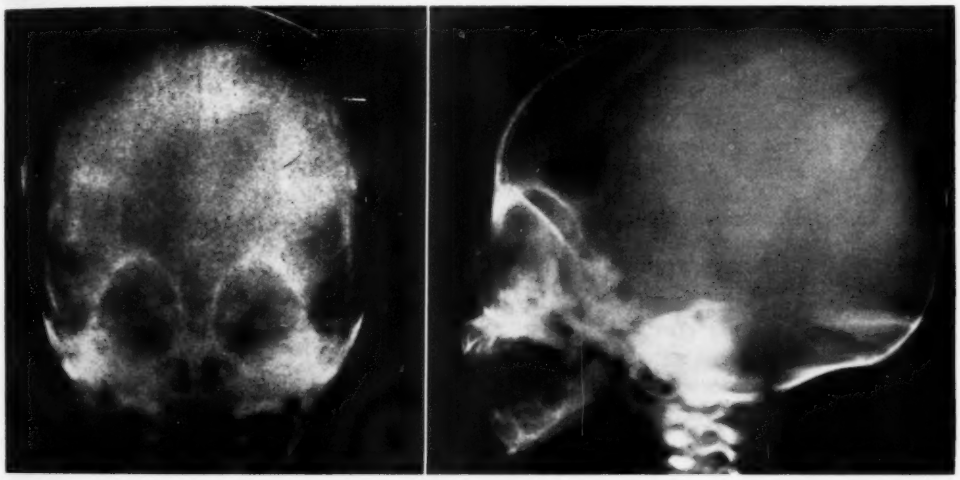

Fig. 3. Case II. Roentgenograms of the skull, taken postmortem. Note the smallness of the frontal bone and of the anterior cranial fossa. The orbits are approximated.

factory nerves and the olfactory bulbs were absent; the optic nerves were hypoplastic; there was a definite lissencephaly; the hemispheres were united, and there was no longitudinal fissure between them except for a small notch posteriorly; the falx, the corpus callosum, and septum pellucidum were missing; the two lateral ventricles formed a single large chamber which contained approximately 150 c.c. of fluid. The weight of the brain, without the ventricular fluid, was 150 gm. The aqueduct of Sylvius was patent.

CASE II: A six-day-old male infant was admitted because of progressive respiratory distress, which started at birth. The father and mother were thirty-six and thirty-four years old, respectively. The father was in good health. The mother, a known diabetic, had had two previous pregnancies. The first child died at two days of age of undetermined cause; the second was living and well. The patient was the product of a normal pregnancy and delivery. The estimated time of gestation was thirty-three weeks. Birth weight was 3,100 gm.

On physical examination, the child was pale, cyanotic, and icteric. The respirations were shallow and irregular, and occasionally gasping. Râles were present in both lungs. The heart sounds were not remarkable. Death occurred two hours after admission.

Roentgenograms of the skull (Figs. 3 and 4),

FIG. 4. A and B. Case II. Postero-anterior roentgenogram of the skull, taken postmortem. A strip of bone including the metopic suture has been removed and is shown in B. Note the segmental obliteration of the metopic suture and the large vascular foramina in the frontal bone along either side of its mid-vertical line.

taken postmortem, showed a small frontal bone, a small anterior cranial fossa, a partially obliterated metopic suture, and a decreased interorbital distance (0.8 cm.). As in the previous patient, the approximation of the orbits was more obvious roentgenographically than clinically.

At autopsy, the body measured 48 cm. in length, and the circumference of the head was 31 cm. (normal, 35.4 cm.). The circumference of the chest at the level of the nipples and the circumference of the abdomen at the level of the umbilicus were 27 cm. (normal, 35 cm.) and 25 cm. (normal, 34 cm.) respectively. The lungs showed gross and microscopic evidence of diffuse bronchopneumonia. The cranium (Fig. 5) had a triangular configuration, with a small, pointed frontal bone. The nose, nasal bones, and nasal cavities were normal, as were the lips, alveolar ridges, and palate. The anterior fontanel was small. At the junction of its middle and the inferior third, the metopic suture was solidly obliterated for a distance of approximately 1 cm. Elsewhere the metopic suture was narrow. The other cranial sutures were normal. Several large vascular channels were present in the inner surface of the frontal bone along each side of the mid-line (Fig. 4, B). The anterior cranial fossa was small and the middle cranial fossa deep. The crista galli was enlarged. The cribriform plate of the ethmoid was narrow and deeply seated. The orbital roofs were high in position, especially laterally. The falx and tentorium were normal.

The brain weighed 260 gm. (normal—335 gm).

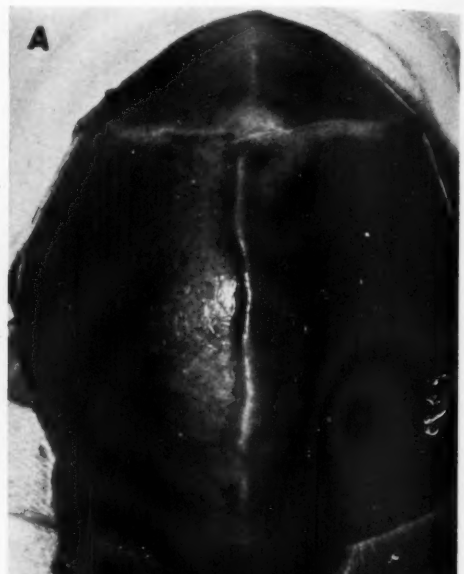

Fig. 5. A and B. Case II. Photograph of the calvarium. A. Superior aspect. B. Frontal aspect. Note the smallness and angulation of the frontal bone and the triangular shape of the calvarium.

The cerebral hemispheres were normally divided and well developed. Corresponding to the narrowing of the anterior cerebral fossa, the frontal lobes were pointed, but when the brain was elevated from the base of the cranium, these lobes assumed a normal configuration, were normal in size, and showed normal sulci and gyri (Fig. 6). All the cranial nerves, and in particular the olfactory nerves (Fig.

6, arrows), tracts, and bulbs, were present and of average size. The corpus callosum and septum pellucidum were well formed. The ventricular system and the rest of the brain were not remarkable.

The cause of death was considered to be related to the usual complications in an infant of a diabetic mother, reflected in the somatic measurements and lung changes.

THE NORMAL INTERORBITAL DISTANCE

Since we could not find in the available literature normal standards for the interorbital distance in infancy and childhood, we have attempted to determine the normal range of this cranial dimension from skull roentgenograms. For the study, nonrotated postero-anterior roentgen projections of the skull of 250 different children were obtained from the files of the Division of Roentgenology, Children's Hospital of Cincinnati. The age range was from birth to twelve years. Practically all patients had been examined roentgenologically for suspected skull fracture or sinusitis. All the films had been interpreted as otherwise normal, and, as far as we could determine, none of the patients had any underlying neurologic disease or congenital malformation.

In practically all instances, the films were exposed at a target-table-top distance of 100 cm., with a patient-film distance of 5 cm. (Potter-Bucky diaphragm). The distance between the medial walls of the orbits was measured at approximately the level of the junction between each medial angular process of the frontal bone with the maxillary and lacrimal bones (Fig. 7).

No attempt was made to correlate the values obtained with the patient's race, with other cranial dimensions, or, in older children, with the status of the metopic suture. A survey of the data on the first 150 children showed no gross difference between the interorbital distance of males and females. The results of this study are shown in Figure 8.

ORBITAL HYPOTELORISM

The term orbital hypotelorism is used here to indicate an abnormal narrowing of the interorbital space. An approximation

Fig. 6. Case II. Photograph of the brain from above. Note the presence of the olfactory nerves (arrows). The crista galli is enlarged. The hemispheres are divided, and the frontal lobes are normal in size and shape and have normal gyri and sulci.

of the orbits is found in arhinencephaly (with or without trigonocephaly), and in trigonocephaly. The occurrence of a narrow interorbital space in these conditions has been noted occasionally in the past. A review of available literature showed that some degree of hypotelorism was present, with a possible rare exception, in all the cases of arhinencephaly and of trigonocephaly in which the interorbital space was commented on or illustrated. We have been unable to discover any instance of hypotelorism occurring as an isolated anomaly or in association with conditions other than arhinencephaly and/or trigonocephaly.

Our Case I is a proved instance of arhinencephaly. As shown in Figure 8, the interorbital distance in this instance was very markedly reduced in comparison with normal. In Figure 8 are also indicated (Case II and crosses) the measurements of the interorbital distances of 9 otherwise apparently normal patients with trigonocephaly, who have had roentgeno-

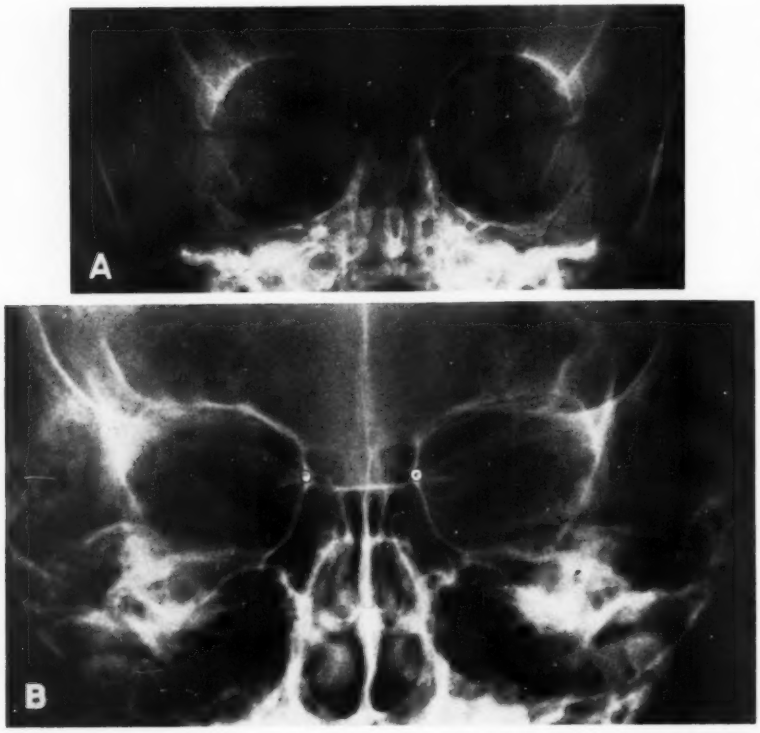

Fig. 7. Postero-anterior roentgen projection of the skull of a normal infant aged one week (A), and of the skull of a normal child aged seven years (B). The white dots indicate the points chosen to measure the interorbital distance for this study.

graphic evaluation in our department. The values obtained are abnormally small or overlap the normal range only at the extreme lower limit (approximately 3 S.D.). As a rule, the hypotelorism presented by these patients was more evident radiographically than clinically, and its severity appeared to parallel the severity of the trigonocephaly. Of the 9 cases of trigonocephaly, only 1 (Case II) is reported in detail, as the status of the central nervous system of the other 8 patients is unknown or incompletely known.

Since the interorbital space is occupied mainly by the ethmoid, it is probable that this bone is narrower than normal when the orbits are close-set, but whether orbital hypotelorism is the result of a primary hypoplasia of the ethmoid bone or is secondary to a more basic cause is not known. As shown in our 2 patients, orbital hypotelorism can occur in association with a normal or with a prematurely obliterated metopic suture; accordingly, a premature synostosis of the two halves of the frontal bone cannot be incriminated in all cases as the basis for a decrease in the interorbital space.

ARHINENCEPHALY

Arhinencephaly (2, 5, 7, 10, 11, 13, 14, 18–21) is the term introduced by Kundrat (11) to indicate a family of malformations whose most characteristic feature is an almost uniformly bilateral absence of the olfactory nerves and often, also, of other parts of the rhinencephalon. Although absence of the olfactory nerves occasionally occurs as an isolated lesion, in general this anomaly has the peculiar tendency to be associated with other malformations, which in many respects are similar to those seen in cyclopia. Because of this similarity, arhinencephaly and cyclopia are considered

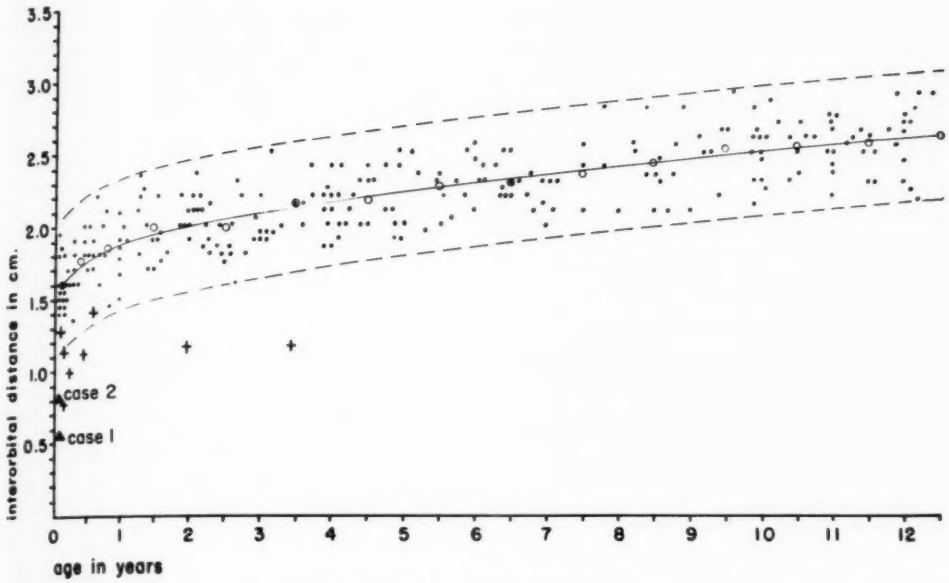

Fig. 8. Scattergram of measurements (black dots) of the interorbital distance obtained from the skull roentgenograms of 250 apparently normal children ranging in age from birth to twelve and a half years. The uninterrupted line unites the calculated mean of the values obtained for certain age groups (open circles); the broken lines represent 3.291 standard deviations above and below the mean and comprise 99.9 per cent of the normal. (Pooled standard deviation for all age groups = 0.1924.) The solid triangles represent the interorbital distance of Cases I and II of this report. The crosses indicate the interorbital distance of 8 additional patients with trigonocephaly observed in this institution during the last five years.

to be closely related developmentally and are usually discussed together. In both, the lesions are limited mainly to structures originating from the most rostral portion of the early embryo, namely, the cranio-fronto-nasal process region and the anterior part of the forebrain. An arrest in the embryological development of these structures has been hypothesized as the cause of such malformations, but what determines the arrest remains obscure. Before the appearance of Kundrat's monograph (11) on arhinencephaly, the only known types of the entire cyclopia-arhinencephaly group of malformations were cyclopia, ethmocephaly, and cebocephaly. All these malformations had been grouped by Geoffroy Saint-Hilaire (7) in two families of monsters (*monstres cyclocéphaliens*): those characterized by a single orbit, and those with two separate but approximated orbits. Kundrat (11) enlarged the second group to include other less severe forms, and renamed this group "arhinencephaly" from the constant absence of the rhinencephalon.

Cyclopia: In contrast to arhinencephaly in which the orbits are separated although closer together than normal, the cyclopic monsters characteristically have a single orbit in the nasal region. One and sometimes two more or less fused or malformed eyes are present within the orbit. A proboscis is usually found above the orbit. The nose, nasal cavity, and nasal bones are absent, as are the ethmoid, vomer, lacrimal bones, turbinates, and the premaxilla. The maxillae are underdeveloped, lack the nasal process, and are either fused or in direct contact. The frontal bone is narrow, often single, and sometimes keel-shaped. The metopic suture may be prematurely obliterated; not uncommonly the frontal bone originates from a single mid-line ossification center. The anterior cranial fossa is small, the sphenoid is underdeveloped, and there is only one optic canal. The head is often small.

The forebrain is single; the two hemispheres are fused and, instead of two separate lateral ventricles, there is a single, often large chamber, which communicates freely with the third ventricle. Correspondingly, the interhemispheric fissure is absent or rudimentary, and the falx, septum pellucidum, and corpus callosum are missing or incomplete. A large thin-walled cavity, the so-called dorsal cyst, lying between the single forebrain and the cerebellum, and communicating freely with the single ventricle anteriorly and the third ventricle inferiorly, is found in many instances. Hydrocephalus may be present. The optic system, corpora striata, and thalami are variously affected. The olfactory nerves are absent in most, if not all, cases. Infants affected by cyclopia, as well as those with a severe form of arhinencephaly, are either stillborn or die shortly after birth.

Forms of Arhinencephaly: An often cited description of the various forms of arhinencephaly, based on Kundrat's work (11), is that given by Ernst (5) in Schwalbe's "Morphologie der Missbildungen." This series of monographs on malformations, published fifty years ago, has never been translated into English and is generally unavailable. For convenience of the reader, a translation of Ernst's description is included here.[2]

1. *Ethmcoephaly* (ἠθμός, sieve) is the rarest form [of arhinencephaly] and occurs not only in man but also in the lamb and the calf. It differs from the most pronounced forms of cyclopia in that there are two separate orbits and bulbi. The nose is absent or replaced by a trunk (proboscis), whose penis-like appearance gave rise, in ancient times, to odd interpretations. The forehead is small and the frontal suture is obliterated. The nasal bones, premaxilla, the septum of the ethmoid, and the turbinates are absent. The lacrimal and palatine bones are fused. The main feature, however, is the absence or underdevelopment of the olfactory nerves and lobes, remnants of which may be represented by very thin unmyelinated nerves. The optic nerves may bifurcate at the dura after a single origin. The forebrain consists of an oblong thin-walled cavity which does not cover the mid-brain.

2. *Cebocephaly* (κῆβος, monkey): A flat and rudimentary nose is present in its normal position. The flat root of the nose is reminiscent of the platyrrhine monkeys, from which the name originates. In the pig and lamb, the malformation is not so rare as in man and, in fact, it is in the pig that the entire group of cyclopic malformations is most frequent. The skull and face are small. On the forehead there is a keel-like protrusion. The anterior cranial fossa is narrow, the sphenoid is small and short, and the ethmoid bone is defective. The optic foramina lie close together in a common bony canal which is divided only by a membrane. The nasal septum and the premaxilla are absent. The nasal bones and turbinates are rudimentary. The maxillae are fused. The forebrain is simple; it lacks the falx, corpus callosum, septum pellucidum, and anterior fornix, and forms a cap which is fused with the diencephalon. A thin-walled cyst fills the free space between the forebrain, diencephalon, and mid-brain. The thalami are fused, and sometimes a median groove runs backward in the direction of the aqueduct; the corpora striata are either partially or completely absent. The descending crura of the fornix pass into the Ammon's horn. The single ventricle extends laterally into the open temporal horns. The epiphysis, infundibulum, corpora mammillaria, lamina perforata anterior, and the olfactory nerves are absent. The cerebral peduncles are poorly differentiated. The cerebellum is defective and leaves the fourth ventricle open. Microphthalmia, anophthalmia, malformations of the external ears, heart, diaphragm, and jaws, bicornuate uterus, and hydrops of the eustachian tubes are additional findings. Transition forms to cyclopia do exist.

3. *Arhinencephaly with Median Cleft Lip:* This is the most common and best known form which can occur also in living subjects. These patients are brought to the physician because of "harelip." Yet, the median wide-open cleft (1 cm.) corresponds to the missing philtrum and is confluent with the single nasal opening. The nose is flat and the eyes lie close together. The palate is usually cleft and the forehead is often keel-shaped. The premaxilla, nasal septum, horizontal plate of the ethmoid, and crista galli are absent. The single nasal cavity is narrow in its upper and low in its posterior aspect, and often it has closed choanae and fused upper turbinates. As in cebocephaly, the optic foramina are jointed. The small frontal bone is divided, or, through a fusion of the ossification centers, it is single. The falx is absent or incomplete. The forebrain is small and single. The corpora striata are absent; the thalami are fused and the basal parts of the diencephalon are incompletely formed. The olfactory nerves and lobes are entirely absent. Caudally to the mid-brain, the pons, medulla oblongata, and cerebellum are usually present, but the corpora quadrigemina may be malformed.

[2] By permission of Gustav Fischer Verlag, Jena.

Within this group there are gradation forms: for example, the posterior margin of the forebrain may show a notch as a demarcation of the posterior lobes. If the tracts are absent, the optic nerves originate directly from the floor of the diencephalon. Narrow carotid arteries supply only the meninges. Polydactyly in all four extremities, cardiac septal defects, persistence of the truncus arteriosus communis, pulmonary stenosis, microphthalmia, malformations of the external and internal ear, umbilical hernia, diaphragmatic defects, and spina bifida are additional findings. The combination of absent premaxilla, nasal septum, ethmoid plate, and rhinencephalon, together with a rudimentary diencephalon and a simple forebrain, makes this form of median cleft of the upper jaw a special type of malformation. The longest survival has been twenty days; however, the malformation of the brain does not preclude longer life.

4. *Arhinencephaly with Lateral Cleft Lip and Cleft Palate, Often Associated with Trigonocephaly:* There is a synostosis of the two halves of the frontal bone, or even a fusion of the two ossification centers in one protuberance, indicating an intimate union rather than a synostosis. The forehead is therefore small and keel-shaped. This gives rise to a trigonocephaly with a broad biparietal diameter. Correspondingly, the frontal lobes are pointed and the rhinencephalon is absent, whereas the posterior lobes are broad. There may be various gradations according to whether or not a falx divides the forebrain in two parts; a rudimentary median fissure can be present. The absence of the corpus callosum and anterior fornix, the fusion of the corpora striata and thalami, and the uncovered corpora quadrigemina and cerebellum are reminiscent of the previous three serious forms. However, the nasal septum, premaxilla, and the ethmoid plate are rudimentary but present. The maxilla and palatine bones are not fused, thus giving origin to a cleft lip and a cleft palate. Death supervenes after several days as a consequence of the cleft palate rather than from the brain malformation. Microphthalmia, polydactyly, auricular tags, umbilical hernia, and cardiac defects are complications.

5. *Arhinencephaly with Trigonocephaly* is the mildest form in which there are no facial malformations. Only the smallness of the keel-shaped forehead (caused by an early synostosis of the frontal bones) and microphthalmia manifest this type externally. Without defects of the nasal apparatus, there is complete absence of the olfactory nerves. The basal parts of the forebrain and diencephalon are rudimentary. Survival is not precluded, which naturally explains the physiologic interest in this form.

One could establish a *sixth form* which is manifested externally by a mild degree of microcephaly but internally by malformations of the forebrain and absence of the olfactory nerves. As a *seventh form*, one could list absence of the corpous callosum as an expression of a tendency to fusion of the forebrain. Accordingly, many, if not all, cases of absence of the corpus callosum would then find a place in this morphologic series.

Case I of this report is almost certainly an instance of the third or most common form of arhinencephaly. The orbits were approximated. The olfactory nerves and bulbs were absent. The forebrain was undivided and the corpus callosum and septum pellucidum were missing. The nasal cavity was unseptate. The horizontal plate of the ethmoid bone, crista galli, nasal philtrum, and premaxilla were missing.

TRIGONOCEPHALY

Trigonocephaly (1, 6, 9, 12, 15–17, 23) or oöcephaly is a congenital cranial malformation in which a small and pointed forehead, together with a tendency toward an increase in the biparietal diameter, gives the head a triangular or egg-shaped configuration (Figs. 5 and 9). This anomaly was first described by Welcker (23) in 1862. In well developed instances, the angulation of the forehead is sharp, a vertical bony ridge can be palpated in its median line, and the two frontal eminences are absent or rudimentary. In milder forms, the angulation of the forehead is smooth. An incomplete form of trigonocephaly, in which the forehead is rounded and the two frontal tuberosities are well developed but closer together than average, has also been mentioned.

There are two types of trigonocephaly: a simple trigonocephaly in which the cranial deformity is not associated with any abnormality of the brain, as shown by Case II of this report, and a more complex form occurring in arhinencephaly (and in some cases of cyclopia), in which the rhinencephalon and often other parts of the forebrain are defectively developed. These types of central nervous system malformations have been reviewed in the preceding section. (We have been unable to find any case of trigonocephaly occurring in association with other types of brain

anomalies.) The relative incidence of the two forms of trigonocephaly is unknown; however, the fact that a triangular head is not a very rare malformation in pediatric practice, whereas absence of the olfactory nerves is rarely met with at the autopsy table, would suggest that simple trigonocephaly is of more common occurrence than trigonocephaly associated with arhinencephaly.

A large percentage of patients with trigonocephaly are otherwise normal. The belief, first formulated by Küstner (12), that patients with this cranial deformity tend to die at an early age, to be mentally retarded, or to be affected by other malformations, probably applies more to trigonocephaly associated with arhinencephaly than to simple trigonocephaly. A mongoloid slant of the palpebral fissures, as shown in Figure 9, A, has been observed in patients with proved arhinencephaly (with or without trigonocephaly) and in simple trigonocephaly (Case II of this report), but whether or not these patients were actually affected by mongoloid idiocy is not known.

When trigonocephaly is associated with cyclopia or one of the more severe forms of arhinencephaly, the basic disease can be recognized easily from the characteristic external features. A diagnostic problem arises in the presence of a mild form of arhinencephaly in which the affected patients can be entirely normal externally or show only trigonocephaly. Similar difficulties exist when one is confronted with a dry skull affected by trigonocephaly. The osseous changes of cyclopia and severe forms of arhinencephaly are fairly typical and have already been enumerated; suffice it here to recall that in such malformations the frontal bone is not uncommonly single (single mid-line ossification center), even when trigonocephaly is present.

The bony lesions of simple trigonocephaly and of trigonocephaly associated with a mild form of arhinencephaly appear to be the same, except that in arhinencephaly the lamina cribrosa of the ethmoid is almost always imperforate. The vestiges of the two frontal ossification centers lie closer together than normal. The metopic suture is obliterated prematurely in part or completely, apparently in all cases. The possibility that trigonocephaly can occur in the presence of an open metopic suture has been mentioned by some authors (4, 17), but, to our knowledge, no well documented instance of this type of trigonocephaly has yet been reported. A synostosis of the two halves of the frontal bone was demonstrated roentgenographically or postmortem in all of our 9 cases of trigonocephaly. When the obliteration of the metopic suture is incomplete, the obliterated segment is located usually at the junction of the middle with the inferior one-third of this suture. The internal frontal crest is usually thickened and, commonly, large vascular foramina are present in the inner aspect of the frontal bone on either side of its medial line (Fig. 4, B). The orbits tend to be closer together than normal, and their inferior lateral angle is sometimes low-set. The orbital roofs are much higher than normal in relation to the horizontal plate of the ethmoid; their medial wall may appear thickened. The anterior cranial fossa is small. The sphenoid tends to be reduced in size. The crista galli is often enlarged; in arhinencephaly this structure may be absent. The lamina cribrosa of the ethmoid is frequently narrow and deeply seated, and the horizontal portions of the frontal bone tend to be approximated.

The cause of trigonocephaly is still controversial. It is commonly believed that this cranial malformation is due to a premature obliteration of the metopic suture, probably related to a defective anlage of the frontal bone or of the metopic suture. As is known, obliteration of the metopic suture normally begins in the inner surface of the frontal bone during the last quarter of the first year of life and is complete between the second and third years or slightly later; persistence of the metopic suture into adult life occurs in approximately 10 per cent of individuals and is known as "metopism" (3, 22).

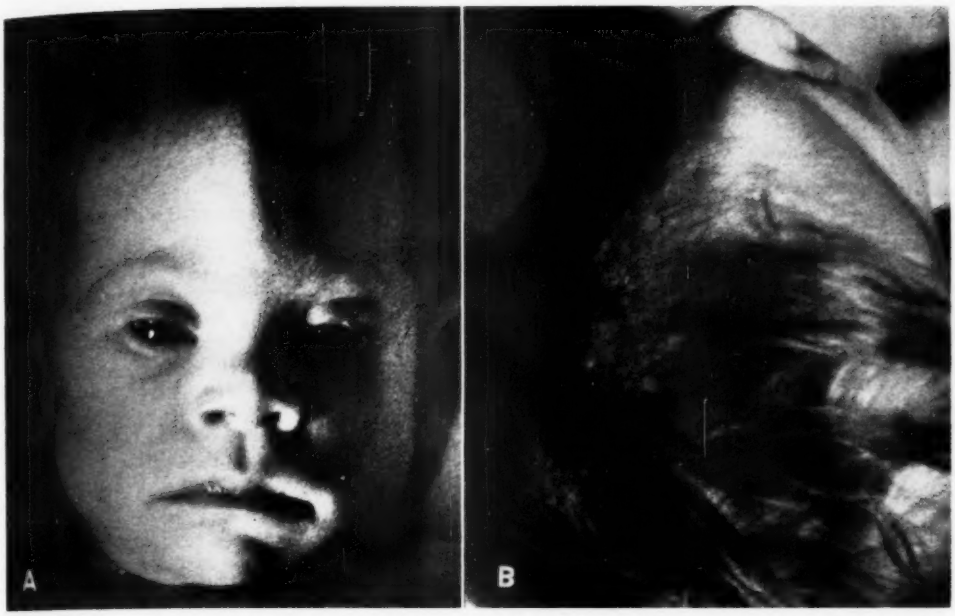

Fig. 9. Photographs of a patient with typical trigonocephaly. This case is not reported in more detail in this paper, as the status of the rhinencephalon is not known. A ventriculogram showed nothing unusual. Note the angulation of the forehead and the increased biparietal diameter. The mongoloid slant of the palpebral fissures, which apparently is not an uncommon finding in trigonocephaly and in arhinencephaly, is well shown. The width of the interorbital distance, obtained in the skull roentgenograms of this patient, is indicated in Figure 8 by the cross situated just to the right of the triangle of Case II.

According to the theory that premature closure of the metopic suture causes trigonocephaly, it is assumed that the transverse growth of the frontal bone is thereby retarded, thus maintaining and exaggerating the triangular configuration of the cranium which is present normally in early fetal life. It has been suggested that the earlier this obliteration, the more severe is the deformity, and that an incomplete form of trigonocephaly is apt to result if the two halves of the frontal bone unite near birth or in early infancy. In contrast to this view, there are writers (11, 17) who maintain that the bony changes of trigonocephaly are secondary to hypoplasia of the forebrain. While possibly valid in some instances, this hypothesis does not seem to apply to all cases of trigonocephaly, inasmuch as the brain can be entirely normal, as shown by Case II of this report. It is not known whether the cause of the triangular shape of the skull in simple trigonocephaly and the cause of the trigonocephaly which occurs in arhinencephaly and in cyclopia are the same.

From the practical point of view, a defectively developed rhinencephalon and forebrain should always be suspected in the presence of a well developed trigonocephaly, particularly if there are other abnormalities which are often associated with arhinencephaly, such as an undivided nasal cavity, absence of the philtrum, absence of the premaxilla, microphthalmia, microcephaly, and neurological and mental defects. The status of the olfactory apparatus cannot be evaluated satisfactorily, particularly in early life, but the degree of development of the corpus callosum and related structures and the degree of division of the two hemispheres and lateral ventricles can be assessed by pneumoencephalography. This diagnostic procedure is probably to be recommended in at least all severe cases of trigonocephaly.

A surgical method for a complete correction of the deformity of the forehead

in trigonocephaly apparently is not available. Some cosmetic improvement can be obtained by a vertical craniectomy in the frontal bone, by which the apex of the angle present in the mid-ventral line of this bone is removed surgically. An extension of the craniectomy to include the whole length of the metopic suture does not appear feasible or desirable in view of the anatomic relations of the caudal portions of the suture. Spontaneous improvement in the angulation of the frontal bone in trigonocephaly may occur, according to some authors (6, 9) and should be kept in mind, especially when the deformity is not severe.

CONCLUSIONS AND SUMMARY

The relations between orbital hypotelorism, arhinencephaly, and trigonocephaly have been discussed, and 2 cases illustrating these three malformations have been reported. An attempt has also been made to establish from skull roentgenograms the normal range of the interorbital distance.

Orbital hypotelorism indicates an abnormal narrowing of the interorbital space. The malformation is often more obvious radiographically than clinically and is a frequent, if not constant, finding in arhinencephaly and in trigonocephaly. It is not known whether orbital hypotelorism occurs also as an isolated anomaly or in association with conditions other than arhinencephaly and trigonocephaly.

Arhinencephaly is a family of malformations closely related to cyclopia and characterized by an absence of the olfactory nerves and frequent association of other fairly characteristic developmental lesions of the brain and craniofacial structures.

Trigonocephaly (triangular head) is a cranial anomaly in which the frontal bone is small, narrow, and pointed and in which the metopic suture is prematurely obliterated, partially or completely, apparently in all cases. Trigonocephaly can occur in association with arhinencephaly or as an isolated lesion (simple trigonocephaly).

The presence of orbital hypotelorism, as well as of trigonocephaly, should always arouse the suspicion of a maldeveloped rhinencephalon and forebrain, particularly in the presence of other external anomalies which are known to occur frequently in association with arhinencephaly, such as a deformed nose, an undivided nasal cavity, absence of the premaxilla, a median cleft in the upper lip, microphthalmia, and microcephaly.

ACKNOWLEDGMENT: Acknowledgment is gratefully made to Dr. Theodor Sterling, Biostatistician, Department of Preventive Medicine, University of Cincinnati College of Medicine, for the statistical analysis of the data on normal interorbital distances, and to Dr. Benjamin Landing, Pathologist of the Cincinnati Children's Hospital, for the use of the autopsy material in the two cases reported here.

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SUMMARIO IN INTERLINGUA

Hypotelorismo Orbital, Arhinencephalia, e Trigonocephalia

Le relationes inter hypotelorismo orbital, arhinencephalia, e trigonocephalia es discutite. Duo casos que illustra iste malformationes es reportate. Esseva etiam interprendite le tentativa de establir ab roentgenogrammas de 250 juveniles le variationes normal del distantia interorbital.

Hypotelorismo indica un restriction anormal del spatio interorbital. Iste malformation es frequentemente plus obvie in le radiogramma que in le tableau clinic. Illo es un frequente, si non constante, tracto in arhinencephalia e trigonocephalia. Il non es cognoscite si hypotelorismo occurre etiam como un anormalitate isolate o in association con conditiones altere que arhinencephalia e trigonocephalia.

Arhinencephalia es un familia de malformationes que es intimemente relationate con cyclopia e que es characterisate per le absentia del nervos olfactori e per le frequente association con altere satis typic lesiones disveloppamental del cerebro e del structuras craniofacial.

Trigonocephalia (=capite triangule) es un anormalitate cranial in que le osso frontal es micre, pauco large, e acute e in que le sutura metopic—apparentemente in omne casos—es partial- o completemente oblitterate ante le tempore normal. Trigonocephalia pote occurrer in association con arhinencephalia o como lesion isolate.

Le presentia de hypotelorismo orbital e etiam de trigonocephalia deberea semper eveliar le suspicion de un imperfection del disveloppamento rhinencephalic e prosencephalic, specialmente in le presentia de altere anormalitates externe que occurre cognoscitemente in association frequente con arhinencephalia. Tales es deformitate nasal, non-dividite cavitate nasal, absentia del premaxilla, fissura median del labio superior, microphthalmia, e microcephalia.

Congenital Mesodermal Dysmorpho-Dystrophy

(Brachymorphic Type)[1]

S. B. FEINBERG, M.D.

AS FORMIDABLE as the term dysmorphodystrophia mesodermalis congenita sounds, it is more inclusive and descriptive than the many other terms applied to the different manifestations of congenital mesodermal dystrophy (1, 8, 9). This statement is prompted by our evaluation of the applicability of the diagnosis of Marchesani's syndrome to two sisters with multiple striking findings.

Marchesani's syndrome *per se* has not been reported in either the American or foreign roentgen literature. It has, however, appeared in foreign ophthalmologic journals (1, 5–8) and recently in American publications in other fields (3, 9). Specifically, the syndrome includes short stature, a brachycephalic skull, brachydactyly, well developed subcutaneous tissues, myopia, and glaucoma, with frequent association of spherical and/or dislocated lenses. In addition, congenital heart defects have been reported (1, 2, 9).

In spite of these specific features, not all cases recorded in the literature have had exactly the same findings. Thus, the comments and classifications of Marchesani, Weve, and Schmid (1, 8, 5) not only are convenient, but also represent a step in the right direction in eliminating the use of eponyms for each variation of the "broad spectrum" of the related but slightly different entities.

CASE REPORTS

G. G., a 10-year-old girl admitted to the University of Minnesota Hospitals on June 11, 1958, was described by her mother as having been "different from birth." Her eyes were depressed and "rolled," and she was unable to open them fully. She ate poorly and was slow to develop. She had suffered repeated respiratory infections, otitis, poor vision associated with headaches, fatigability, and recurrent ulcerations of the feet, especially in winter. A heart murmur was discovered at six months of age.

On admission, the patient was noted to have a low hair line with abundant hair extending down her forehead and neck. Her forehead was broad; her head was brachycephalic; her eyelids were narrow, and the lid fissures exhibited a reversed angulation of the lateral margins. The globes were small; the pupils reacted to light but accommodated poorly. Nystagmus was noted on right lateral gaze. Upward gaze was limited. Vision was 20/400 bilaterally. Funduscopic examination showed flat, poorly defined disk margins. The media were clear.

The ears were small and the preauricular folds were prominent. There was an anterior perforation of the left drum and an anterocentral perforation of the right drum.

The maxilla was hypoplastic, presenting a "collapsed" appearance. Associated with this was a high arched palate with maldeveloped, deformed, and misdirected teeth. As a result, the mandible appeared to be prognathic. The neck was broad.

In addition, the patient had a suprasternal thrill without a precordial thrill. A diastolic machinery murmur heard along the sternal margin was indicative of a patent ductus arteriosus.

The fingers and toes were short and broad. The hands showed ulnar deviation and thickening of the skin. The skin folds over the thighs were also thickened. There was a 2.5-cm. umbilical hernia. The labia were hypoplastic.

X-ray Findings: The skull was markedly brachycephalic. The orbits were hypoplastic, asymmetrical, and closely placed. The maxilla was depressed and hypoplastic. The zygomatic arches were present. The teeth were malformed and maldirected. The palate was high. The mandible was relatively prognathic, due to the hypoplastic maxilla (Fig. 1). The long bones were normally developed even though somewhat small. The metacarpals and metatarsals as well as the phalanges were short. Bone age was somewhat retarded (Fig. 2).

Chest studies showed no cardiac enlargement but revealed a prominent undivided portion of the pulmonary artery, a relatively prominent aorta, and increased peripheral vasculature. The left atrium was of borderline size. These findings were compatible with the diagnosis of a left-to-right shunt due to a patent ductus arteriosus. There was relative emphysema (Fig. 3).

On July 8, 1958, surgical correction of the patent

[1] From the Departments of Radiology, University of Minnesota Hospitals and Mt. Sinai Hospital, Minneapolis, Minn. Accepted for publication in March 1959.

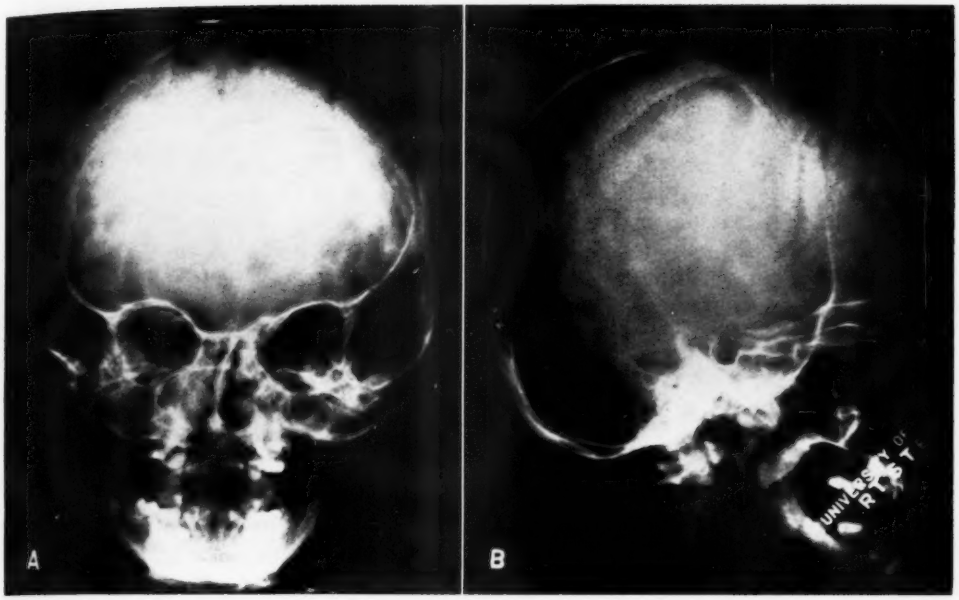

Fig. 1. A. Postero-anterior view of skull of G. G., 10-year-old girl, showing large, broad cranial vault with some asymmetry; small asymmetrical orbits; hypoplastic maxilla. The teeth are malformed and malaligned, with poorly developed roots.

B. Lateral view of skull, showing the large, brachycephalic cranial vault to better advantage. The depressed hypoplastic maxilla is also a striking feature. The shallow orbits are well demarcated. The mandible is relatively prognathic. The abnormality of the teeth can be seen in this plane as well.

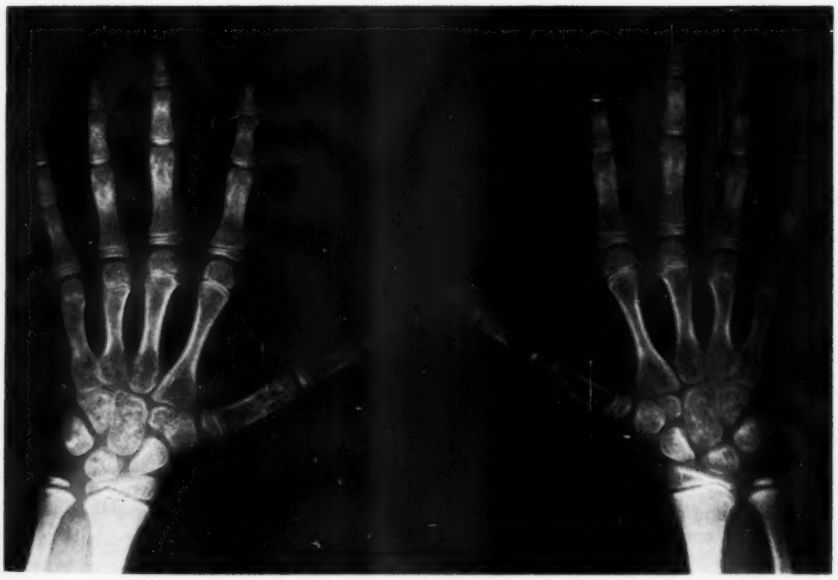

Fig. 2. G. G. Roentgenograms of the hands show some retardation of bone age, with short metacarpals and phalanges, which account for the broad, thick hands and fingers seen clinically.

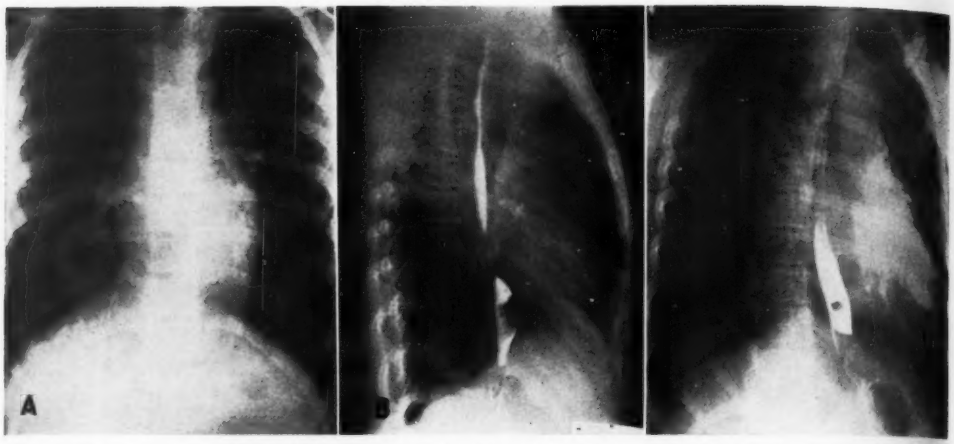

Fig. 3. G. G. A. Postero-anterior view of chest. There is no cardiomegaly, but the pulmonary artery and its peripheral branches show a definite increase in peripheral blood flow. The aorta is slightly elongated and prominent. There is some emphysema.

B. Right lateral view of chest, showing some encroachment on the retrosternal space by the right heart. There is minimal but definite impingement of the left atrium on the barium-filled esophagus.

C. . Right anterior oblique view of chest, showing above mentioned findings in another projection. All of the changes indicate a left-to-right shunt compatible with the diagnosis of patent ductus arteriosus.

ductus was performed. The patient was discharged July 19, 1958.

N. G., 7-year-old sibling of G. G., was very much like her sister from birth. She had the same prominent forehead, small sunken eyes, with lids which she could not completely open. Rolling of the eyes was also a prominent finding. Motor development was slow. A heart murmur was discovered at the age of four. Recurrent ulcers of the feet were particularly troublesome in the winter. The child tired easily and had frequent epistaxis. With her sister, the patient was admitted to the University of Minnesota Hospitals on June 11, 1958. She, too, was found to have a strikingly brachycephalic head with abundant coarse hair and a hair line low on the forehead and neck. The eyes were small and depressed with reversed lid angles. The globes were small, with bilateral 1-mm. central corneal opacifications. No iridonesis was noted. The pupils reacted to light and showed poor accommodation. Superior gaze was restricted. The cups were flat, and the fundi were faint. The disk edges were hazy. One observer mentioned an anteriorly displaced lens on the right, but another disagreed with this finding.

The ears were small. As with G. G., a deprsseed maxilla with a relatively prognathic mandible was a striking feature. The teeth were malaligned and separated. The palate was highly arched. This child, too, had a machinery murmur to the left of the sternum. Her complete cardiac findings were also in keeping with the diagnosis of patent ductus arteriosus. There was a diastasis recti. The labia were hypoplastic.

The hands and feet were short and broad, as well as thick. The skin folds, especially about the hands and thighs, were thickened, and the hands showed ulnar deviation.

X-ray Findings: The skull was strikingly brachycephalic. The orbits were asymmetrical, shallow, and hypoplastic, with a relatively short interorbital distance. The maxilla was hypoplastic and depressed. The zygomatic arches were present. The teeth were maldeveloped, especially the roots, and malpositioned. The mandible was relatively prognathic (Fig. 4).

The chest findings were more abnormal than those of the sister. The peripheral vascular pattern was more prominent. The heart was not large but also showed minimal prominence of the undivided portion of the pulmonary artery and aorta. The roentgen findings were compatible with the diagnosis of patent ductus arteriosus (Fig. 5).

The metacarpals, metatarsals, and phalanges were short and broad (Figs. 6 and 7). The wrist and hand bone age were normal, unlike those of G. G. The long bones were somewhat short but not broad.

Cardiac surgery was performed, with closure of a patent ductus. The patient was discharged on July 19, 1958.

The parents of N. G. and G. G. were not knowingly related and were not unusual in stature or appearance. Little is known of the immediate ancestors, but no particular trait which might be considered unusual was acknowledged. Three other siblings in the family were not blood relatives to these two girls (previous marriage).

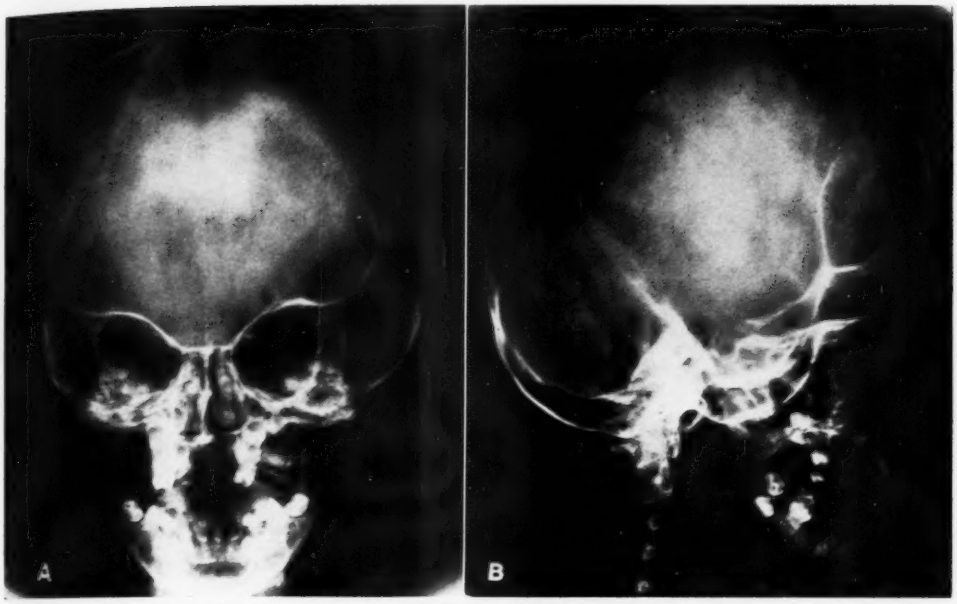

Fig. 4. A. Postero-anterior view of skull of N. G., 7-year-old sibling of G. G. Large cranial vault; thin zones of tables in mid and superior frontal bone; orbits small; maxilla extremely hypoplastic. Teeth are malformed, with poorly developed roots.

B. Lateral view also shows the marked brachycephaly, hypoplastic and depressed mandible, shallow orbits, abnormal teeth, and relative prognathism. This last is partially obscured by anterior angulation of maxillary incisors.

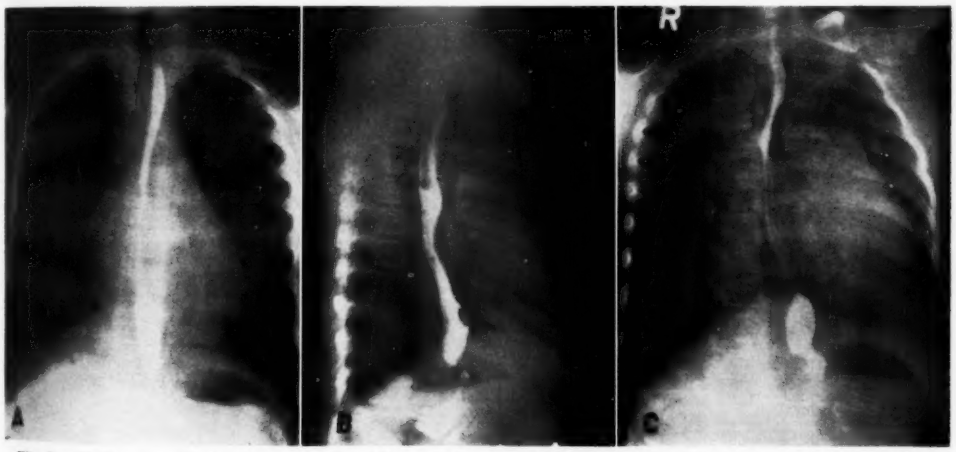

Fig. 5. N. G. A. Postero-anterior view of chest, showing minimal cardiomegaly, accentuation of undivided portion of pulmonary artery, and borderline prominence of aorta. Right and left pulmonary arteries and their peripheral branches are increased, due to a left-to-right shunt. There is relative emphysema.

B. Right lateral view of chest, showing encroachment of right heart on retrosternal space, as well as left atrial enlargement.

C. Right anterior oblique view of chest showing above mentioned findings in another plane. Findings compatible with diagnosis of patent ductus arteriosus.

DISCUSSION

Marchesani (1) first reported his findings in 1939, at which time he described 4 patients, in 2 families, with brachycephaly and spherophakia (small spherical lens), with associated myopia and glaucoma.

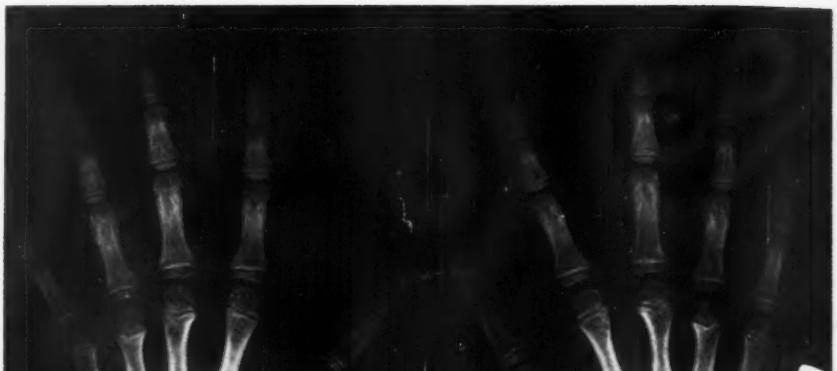

Fig. 6. N. G. Views of both hands, showing short broad metacarpals and phalanges, as well as abundant soft-tissue thickness.

The patients also were of short stature and had obvious brachydactyly. One of the 2 families was the result of the mating of two cousins.

Others (5, 7, 8, 9), including Arjona and Rousseau quoted by Zabriskie, have reported similar findings and have elaborated on the familial tendency for brachycephaly, myopia with or without spherophakia, and displacement of the lens, even though this was not a constant finding. Glaucoma was also a prominent feature in some instances. Short, thick hands and feet were quite universal. Some families exhibited partial syndromes (3, 5, 9).

Congenital heart disease has been included among the frequent associated findings. In one series of 28 autopsied cases of Marfan's syndrome 89 per cent had cardiovascular disease (9). In the 16 reported cases of Marchesani's syndrome, congenital heart disease was a not infrequent finding. The clinically significant patent ductus can account for the early manifestations of fatigability and the somewhat retarded physical development of our 2 patients.

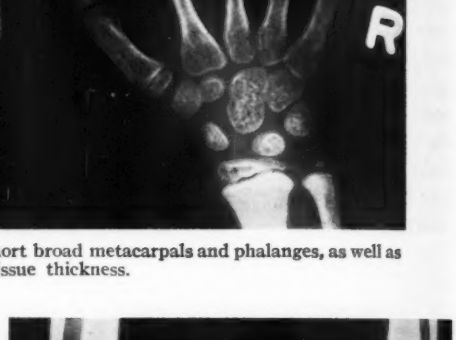

Fig. 7. N. G. Views of both feet, showing short forefeet due to short metatarsals.

Marchesani, Weve, and Schmid (1, 8, 5) have compared the ocular deformities and congenital heart problems as well as the divergent yet developmental relationship of the mesodermal abnormalities in so far as stature, hand and feet size, and ciliary

body are concerned, in Marfan's and Marchesani's syndromes. Marchesani discussed the two relatively opposite entities as the hypoplastic or the arachnodactylic versus the hyperplastic brachydactylic types. Weve used the terms dolichomorphy (type of Marfan) and brachymorphy (type of Marchesani). The ectodermal defect of the spherical and/or displaced lens is secondary to the underlying mesodermal abnormality of the ciliary body.

From the standpoint of this paper, the radiographic findings are of chief significance. The original recognition of the syndrome was due to the many possible ophthalmologic manifestations which are more than adequately documented elsewhere (1, 2, 5–8). These are only a part of the many aspects of the syndrome. In spite of the oft found short stature, some relatively normal heights have also been reported. The skull, facial bones, hands, and feet have been the primary areas of involvement.

Grotesque exaggeration of brachycephaly is the most obvious finding. Associated with this are small, shallow, closely placed orbits. Clinically the interorbital distance might be confusing, due to the smallness of the eyes. The above mentioned skull configuration accounts for the relatively large, broad, flat foreheads. The hypoplastic orbits are directly related to the small myopic globes. The diminutive maxillae with resultant depression of the cheeks can also account for the reversed angles of the eyelids. In spite of the recessed cheeks, the zygomatic arches are present in a proportionately hypoplastic state. The palate is thus deformed, usually arched, as a result of the maxillary abnormality. The mandible is either actually or relatively prognathic, usually the latter (Figs. 1 and 4). These two features, *i.e.*, depressed maxilla and prognathic mandible, set this syndrome apart from craniofacial mandibular dysostosis (4).

The two siblings in the cases reported here had the usual short thick hands and feet, reflecting the short metacarpals, metatarsals, and phalanges. One of the two, G. G., had roentgen evidence of retarded bone age (Fig. 2). N. G. did not. This is probably to be expected. The long bones were the same in both, *i.e.*, small caliber, within the short normal range (Figs. 2, 6, and 7).

The underdeveloped, malaligned teeth are in our opinion another manifestation of the many possible combinations of defects in this grouping (Figs. 1 and 4).

Both patients had abnormal cardiovascular findings clinically and roentgenologically (Figs. 3 and 5), with evidence of left-to-right shunts, prominent undivided portions of the pulmonary arteries, and prominent aortas. There was some prominence of the left atrium. The findings were characteristic of patent ductus. The types of lesions described in the literature have varied (9).

Dysmorpho-dystrophia mesodermalis congenita, or congenital mesodermal dystrophy, appears to be a suitable broad category in which to include the findings described by Marfan at one extreme and Marchesani at the other as suggested by Weve. This is particularly true of the ophthalmologic and roentgen features.

SUMMARY

Two cases of the brachymorphic type of congenital mesodermal dysmorphic-dystrophy in siblings are reported, with particular reference to the roentgen findings.

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SUMMARIO IN INTERLINGUA

Congenite Dysmorpho-Dystrophia Mesodermal (del Typo Brachymorphic)

Es opinate que le termino congenite dystrophia mesodermal es sufficientemente large in su implicationes pro includer le syndrome de Marfan a un extremo e le syndrome de Marchesani al altere. Istos es designate, respectivemente, como le typos dolichomorphic e brachymorphic.

Duo casos del typo brachymorphic, observate in duo fraternos, es hic reportate, con attention special prestate al constatationes roentgenographic. Le cranio, ossos facial, manos, e pedes exhibi le alterationes le plus marcate. Grados exaggerate de brachycephalia es le plus obvie constatation. Associate con isto es micre e pauco profunde orbitas a curte distantia le un ab le altere. Le maxilla es hypoplastic, e le dentes es deformate e mal alineate. Le palato es alte e le mandibula relativemente prognathic. Le arcos zygomatic es presente. Le manos e pedes es curte e spisse, reflectente un accurtamento del ossos metacarpal, metatarsal, e phalangee. Ambe iste patientes habeva associate constatationes de anormalitate cardiovascular indicative de patente ducto arteriose.

Mandibulofacial Dysostosis[1]

JAMES J. STOVIN, M.D.,[2] JAMES A. LYON, JR., M.D., and RAYMOND L. CLEMMENS, M.D.

MANDIBULOFACIAL dysostosis is a congenital syndrome which has been recognized in increasing numbers in the past two decades. This syndrome of congenital anomalies involving the mandible, maxillae, and ears was first noted by Berry (1) in 1889. Since then, 59 cases have been reported in the English and European literature. Some of the cases have been "complete" according to the classification of Franceschetti (8); others have shown only some of the anomalies included in the syndrome. Treacher Collins (5) reported 2 cases in 1900, and his name has since been associated with the syndrome. Franceschetti, who made an extensive review covering most of the cases published up to 1949, is associated with the syndrome in the European literature. Of the 59 reported cases, only 3 appear in the radiologic literature. We have had the opportunity recently to examine roentgenographically 2 brothers and 2 sisters of different families with the syndrome.

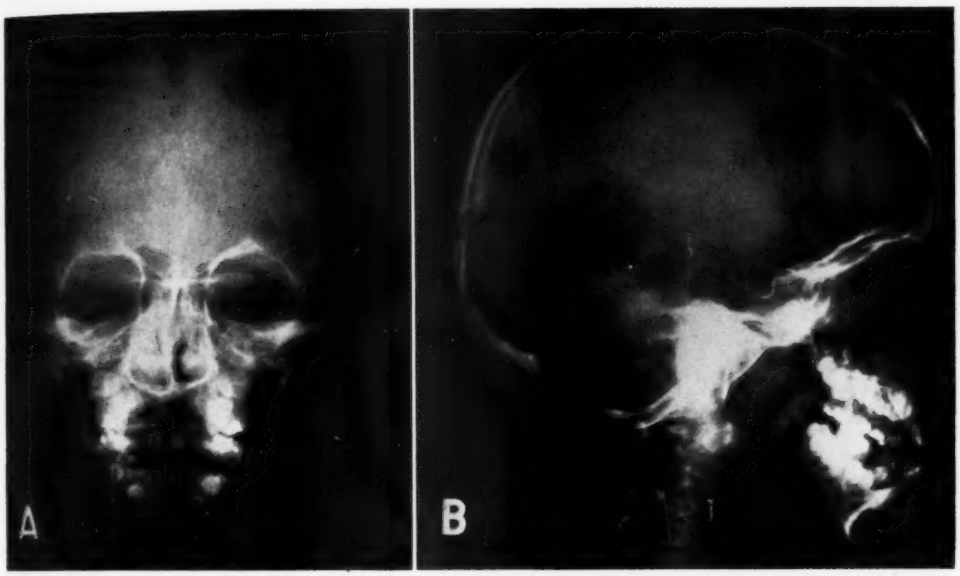

Fig. 1. Case I (K. M., 11 years). A. Postero-anterior projection showing the absence of zygomatic arches and small facial bones. B. Lateral projection showing the sclerotic mastoids and small mandible. The angle of the mandible is more obtuse than normal. The apparent largeness of the calvarium is due to the smallness of the facial bones.

CASE HISTORIES

CASE I: K. M., an 11-year-old white male, was admitted for surgical correction of middle ear deafness due to congenital malformations typical of the Treacher Collins syndrome. An anti-mongoloid slant of the eyes, depressed cheeks, small jaw, and auricular defects were noted at birth. A cleft palate had been corrected in infancy. Deafness was noted when the child, though of normal intelligence, had difficulty in school.

Roentgen examination showed the bony calvarium to be normal (Fig. 1). The apparent enlargement of the cranial vault was due to the comparative smallness of the facial bones and mandible. The mandible was small with the greatest deficiency in the rami. The angle was slightly more obtuse than normal.

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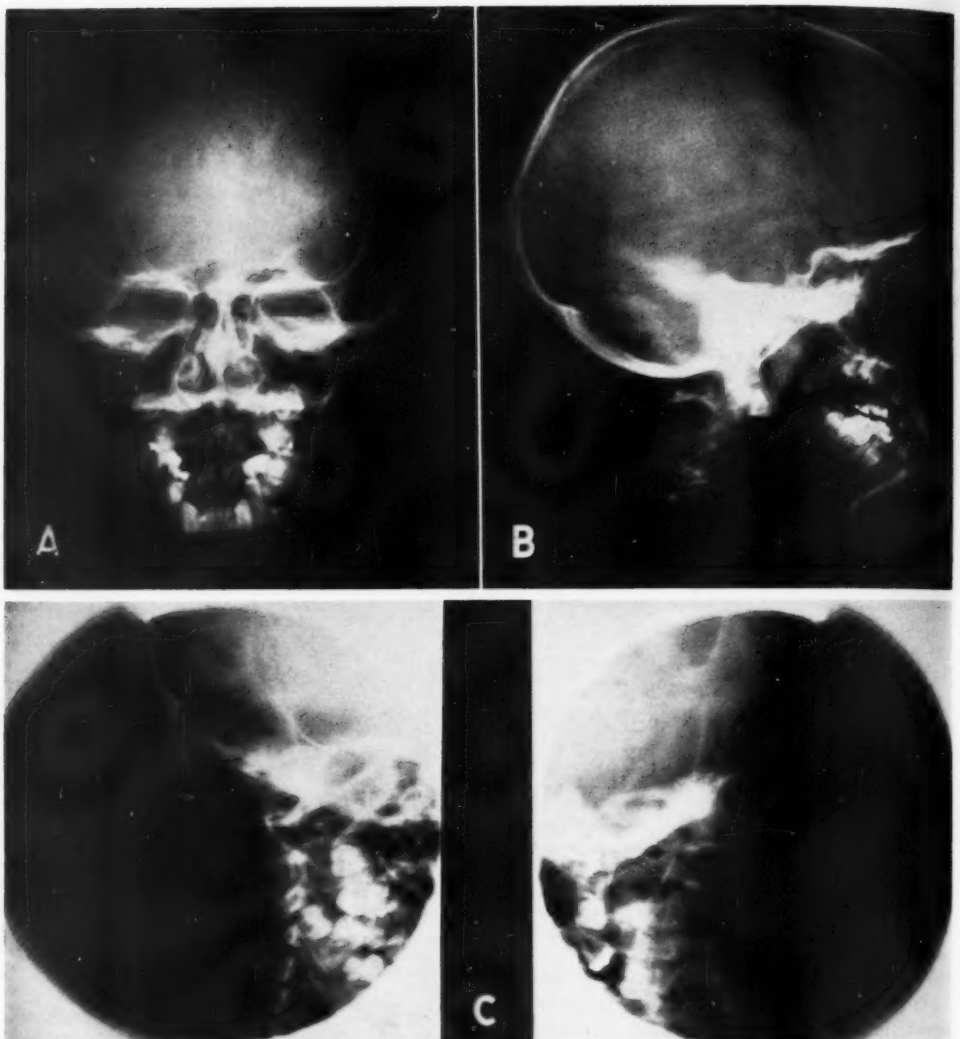

Fig. 2. Case II (M. M., 9-year-old brother of K. M.). A. The zygomatic arches are absent. The facial bones are hypoplastic. B. The mandible is small, with a more obtuse angle than normal. C. The mastoids are sclerotic.

The maxillae were hypoplastic, with incomplete zygomatic arches. The sella turcica was of normal size. The mastoid bones were not pneumatized, and the tips were hypoplastic. There was also sclerosis of the middle and inner ear, with poor delineation of their structures. Bilateral operative defects were present in the tympanic antra.

Surgical exploration of the ear through an endaural incision was undertaken. The mastoid bone was sclerotic without pneumatization. The malformed incus and malleus were fused. The stapes and oval window were absent.

CASE II: M. M., the 9-year-old brother of K. M. (Case I), was admitted for surgical correction of total deafness which was present at birth. Except for those 2 brothers, no members of the family were known to have congenital anomalies associated with mandibulofacial dysostosis. The clinical findings were similar in the 2 cases. A cleft palate repair and cosmetic reconstruction of the malformed auricles were performed in infancy. The testes were undescended.

The roentgenologic findings were similar to those observed in the brother, with comparable changes in

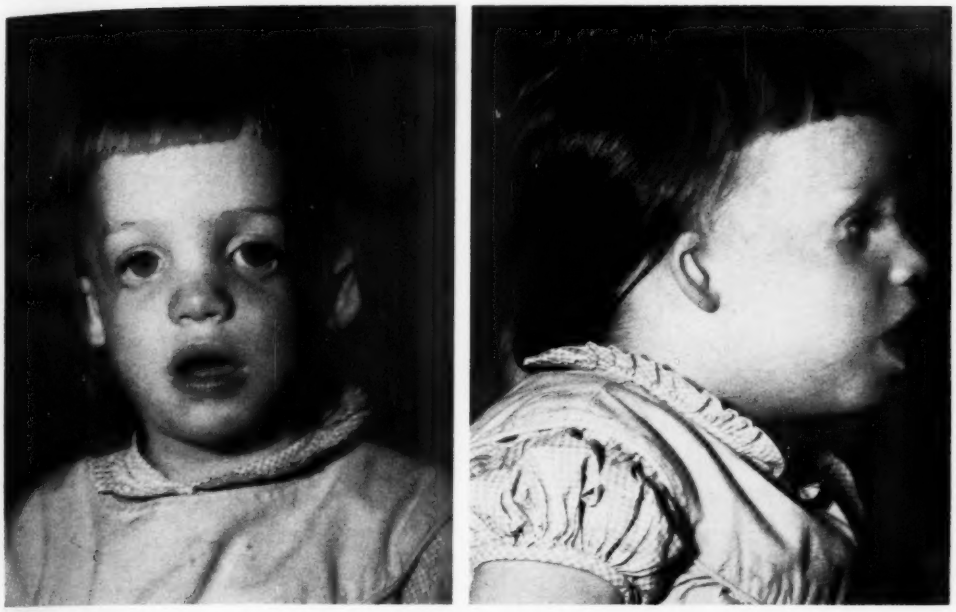

Fig. 3. Case III (D. D., 2 years). Typical features of Treacher Collins syndrome with "anti-mongoloid" slant of the eyes, notching of the lower lids, depressed cheeks (absence of zygomatic arches), and receding jaw. The auricles are misshapen.

the maxillae, zygomata, mandible, and temporal bones (Fig. 2).

An endaural exploratory operation to correct the deafness revealed no mastoid air cells, middle ear, or epitympanic space.

CASE III: D. D., a 2-year-old white girl, was born at University Hospital in 1956 to a normal mother, following a normal gestation. Examination at birth revealed defects in both auricles, notching of the lower lids, depression of the cheeks with a resultant "anti-mongoloid" appearance of the eyes (Fig. 3). The chin was recessive, but no feeding difficulties were encountered. The right external auditory canal was absent, though no apparent hearing loss had been noted. The growth and development had been normal and at the age of two, an I.Q. of 109 was recorded. Inquiry into the family history revealed similar findings in a sister (Case IV), the only other sibling. No other congenital abnormalities were found in an extensive investigation of ancestors and relatives.

Radiologic findings included hypoplastic malar bones and maxillae somewhat smaller than normal (Fig. 4). The size of the mandible was only slightly below normal. The mastoid processes were hypoplastic and lacked pneumatization.

CASE IV: L. D., the 6-year-old sister of D. D. (Case III), gave a history of similar changes noted at birth (Fig. 5). At the age of two years, a plastic procedure for cosmetic correction of the auricles was performed. The patient's I.Q. (Stanford-Binet) was 129. Bilateral hearing defects (50 per cent, left; >30 per cent, right) were present.

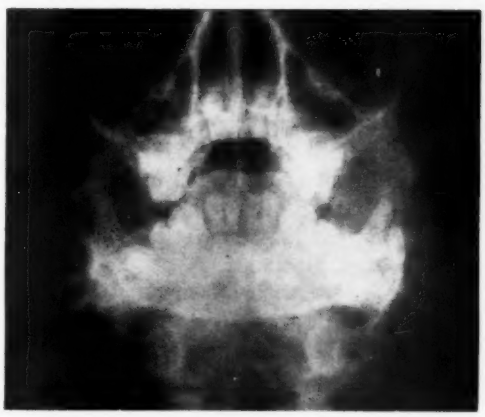

Fig. 4. Case III. Waters' projection reveals the small maxillae and absence of the zygomatic arches.

Roentgen examination of the skull revealed changes similar to those of the younger sister. The most striking features were the absence of the zygomatic arches and the smallness of the facial bones (Fig. 6).

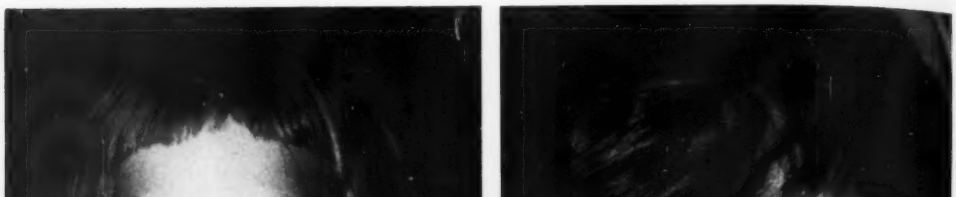

Fig. 5. Case IV (L. D., 6 years). This child shows less of the downward slant of the eyes than her sister (Case III). The depressed cheek is obvious on the right. Only the left lower eyelid is notched. The chin is recessive. The auricular defects have been surgically repaired.

DISCUSSION

The findings in the 63 cases (including our own), both complete and incomplete, reported as mandibulofacial dysostosis or Treacher Collins-Franceschetti syndrome are summarized in Table I. The ratio of males to females is three to two. Though congenital, the condition has been reported in patients ranging from the newborn to sixty-two years of age. Only 2 cases are recorded in Negro children (16, 32), and 1 of these may not be a true example since it lacks several of the important features of the syndrome.

Much stress is placed on the hereditary component of this syndrome. Straith and Lewis (28) described its occurrence in a mother and four children. Sanvenero-Rosselli observed cases in two brothers. Isakowitz (13) reported the syndrome as occurring in one of a set of twins. In 27 of the 63 cases there were definite or suggestive findings in relatives along both ancestral and collateral lines. The exact genetic transmission is not clear, though it has been stated that the syndrome appears to follow an irregular form of dominant transmission.

TABLE I: FINDINGS IN 63 CASES OF MANDIBULOFACIAL DYSOSTOSIS*

Clinical Findings	Number of Cases
Sex	
Male	35
Female	24
Family history	27
"Anti-mongoloid" slant	63
Colobomas lower lid	48
Colobomas upper lid	4
Eyelash defects	31
Malar defects	55
Auricular defects	51
External auditory canal or ossicle defect	23
Deafness	25
Mandibular defects	59
"Hair tongue"	15
High palate	19
Mental retardation	4
Associated deformities	
Cleft palate	9
Hare lip	1
Cryptorchidism	5
Nasal deformity	3
Abnormal extremities	4
Absent parotid	1
Vertebral abnormality	4

* Data are incomplete in some of these cases.

Several theories of etiology have been presented in excellent articles by Mann (17) and McKenzie (20). According to Mann, the embryologic basis is a retardation or

TABLE II: RADIOLOGIC FINDINGS IN 24 CASES OF MANDIBULOFACIAL DYSOSTOSIS*

Radiologic Findings	Number of Cases
Cranial vault	
Normal	6
Accentuated digital markings	8
Dolichocephaly	2
Oxycephaly	1
Persistent frontal suture	1
Sella turcica	
Deep	2
Normal	5
Small	4
Sphenoid sinus small	3
Maxillae hypoplastic	9
Antra	
Small or absent	9
Large	2
Malar bones	
Defective	17
Normal	1
Temporal bones defective	5
Palate	
Short	3
High	2
Ethmoid sinuses	
Large	1
Normal	3
Small	1
Frontal sinuses	
Normal	7
Small	4
Mastoids	
Small processes	7
No air cella	11
Inner ear abnormality	6
Mandible	
Small	9
Obtuse angle	8
T-M joint displaced forward	4

* Data are incomplete in some of these cases.

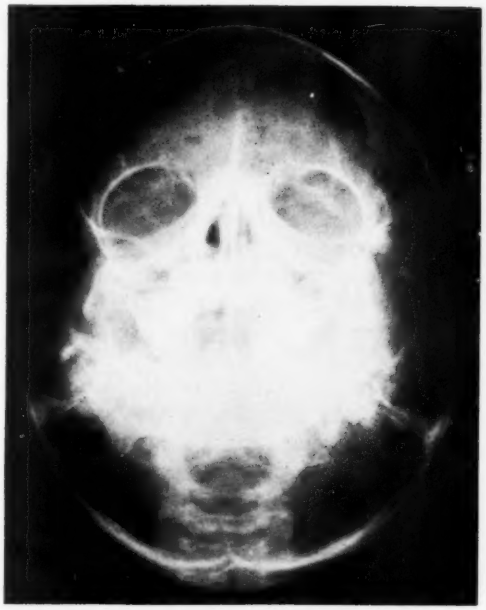

Fig. 6. Case IV. Waters' projection shows the small hypoplastic maxillae and absence of the malar bones.

interference in differentiation of the mesoderm at the 50-mm. stage of development. The other quite different theory of McKenzie places the cause on a vascular basis, with absence of the stapedial artery. His careful dissection of a child of two and one-half months revealed bilateral absence of that vessel.

The congenital defects associated with the syndrome are multiple. Franceschetti attempted to classify the cases according to the number of signs present into "complete," "incomplete," "abortive," and "unilateral" groups. In reviewing the literature, it is impossible so to classify many of the cases because of lack of necessary information. Hence, no attempt has been made to follow Franceschetti's classification, and all of the cases are tabulated according to the features which they present. The most common finding is an obliquely downward slanting of the palpebral fissures, giving an "anti-mongoloid" appearance to the eyes. There is a notching of the lower lids (coloboma) at the junction of the middle and outer thirds. The meibomian glands and intermarginal strip are reported to be absent in some cases.

Hypoplasia of the facial bones is a constant finding. The malar bones are hypoplastic or entirely absent. The zygomatic arches are incomplete, and the infraorbital ridges are defective and depressed. Microtia and defects of the auricles, stenosis or absence of the external auditory canals, middle ear abnormalities, inner ear defects, and deafness are all mentioned as part of the syndrome. A receding hypoplastic mandible is reported in all but 4 of the cases. In addition to being hypoplastic, the angle of the mandible is more obtuse than usual. Malocclusion and associated dental problems result from the micrognathia. Facial "hair-tongue," or an abnormal growth of hair extending forward along the cheeks, and associated blind

fistulae to the skin have been reported, as has macrostomia with a highly arched palate or cleft palate. Other inconstant congenital findings associated with the syndrome are listed in Table I.

Of the 63 patients, 4 were said to be mentally deficient. Most authors stress the average or above-average intelligence of these patients.

While photographs or drawings accompany all except one of the reports, roentgenograms or reports are available for only 24. The radiographic findings are listed in Table II. The chief radiologic finding is the absence of the zygomatic arches or, in one instance, absence of the zygomatic portion of the temporal bones. The maxillae are hypoplastic and the antra small. The mastoid portions of the temporal bones are also underdeveloped, the tips being absent and pneumatization lacking. Inner ear abnormalities are also present. The mandible is small and the angle more obtuse than normal.

The task of correcting the defects of mandibulofacial dysostosis falls to the plastic surgeon, ophthalmologist, dentist, orthodontist, and otologist. Several excellent papers dealing with the surgical correction of the eye, mandibular, and auricular defects have appeared, and that phase of the subject is beyond the scope of this paper. The Treacher Collins syndrome is nevertheless of more than academic interest to the radiologist. The diagnosis does not depend upon the roentgen findings, observation and physical examination of the patient being sufficient. Since deafness of the middle ear type is an almost constant finding, however, and since newer developments in endaural surgery would enable many patients to regain some function, the careful analysis of the middle and inner ear structures by the radiologist is of great help to the otologist in planning the operation. The position of the internal auditory meatus, the location of the lateral sinus, the presence of the tympanic antra and of the semicircular canals, and even the presence of the ossicles can be determined with some degree of satisfaction from a careful radiologic examination. Knowledge of the presence and position of these structures leads to more satisfactory surgery.

SUMMARY

Four cases of mandibulofacial dysostosis are presented. The clinical features of these and 59 reported cases and the radiographic findings of 24 of these cases are tabulated and discussed.

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SUMMARIO IN INTERLINGUA

Dysostosis Mandibulofacial

Es reportate 4 casos de dysostosis mandibulofacial (=syndrome de Treacher Collins), 2 in cata un de 2 familias. Insimul con 59 casos colligite ab le litteratura, illos forma un serie de 63 casos super le quales le observationes del autores es basate. Le defectos congenite que entra in le syndrome es multiple. Le constatation le plus commun es un orientation obliquemente in basso in le fissuras palpebral, lo que imparti al oculos un apparentia "anti-mongoloide". Hypoplasia del ossos facial es un aspecto invariabilemente presente. Microtia e defectos del auriculas, stenosis o absentia del externe canales auditori, anormalitates del aure medie, defectos del aure interior, e surditate es omnes representate in le reportos. Le major constatation radiographic es absentia del arco zygomatic.

Durante que le diagnose non depende del studio roentgenologic, le radiologo—per un caute analyse del structuras del aure medie e interior—pote esser de grande ajuta al otologo in planar le programma chirurgic. Le position del interne meato auditori, le location del sino lateral, le presentia del antros tympanic e del canales semicircular, e mesmo le presentia del ossiculos pote esser determinate con un certe grado de satisfaction super le base de un meticulose examine radiologic.

Silo-Filler's Disease[1]

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SINCE THE AUTUMN of 1954, sporadic cases of an unusual pulmonary disease affecting farmers engaged in filling silos have been encountered. The patients presented a clinical picture of acute illness, with coughing and dyspnea, immediately following exposure to acrid fumes arising from fresh silage. The clinical course thereafter showed considerable variation. Experimental evidence, as well as clinical and pathologic similarity to cases of non-agricultural fume exposure, indicates that the noxious gas is nitrogen dioxide. The disease affecting farmers differs from industrial nitrous fume poisoning, a well known entity, only in the manner of exposure.

Thirteen cases of silo-filler's disease were found in the medical literature (6, 9, 10, 11, 13, 14, 21). Two of these, however, studied by Dickie and cited by Grayson (11), have not yet been reported in detail and are therefore excluded from further consideration because of insufficient information. One case, still under observation by Eckhardt (8), has not yet been published. Thus, detailed information was available in 12 cases in addition to our own. Many more cases have undoubtedly occurred but have not been reported, and it is probable that a large number have not been recognized. Many clinicians, including those in rural areas, are unaware of the disease or are unfamiliar with the possible syndromes it may present. Yet almost any physician may encounter it, since in some cases a latent period of relative normal health, of two or three weeks duration, will enable the victim to travel some distance or even to change his occupation before symptoms appear. The patient may then become seriously or even critically ill within a few days, and the clue of previous fume exposure, so vital to the diagnosis, may have been forgotten. Awareness of the condition on the part of the physician should lead to direct questioning about possible exposure. This is important, since prompt adrenal cortical hormone therapy may be life-saving.

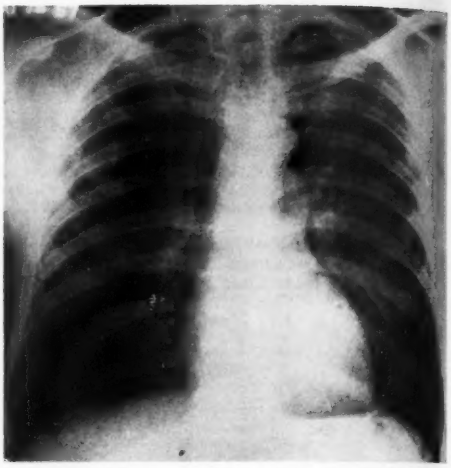

Fig. 1. Case I. Roentgenogram of the chest thirty-four days after exposure to silage fumes. Innumerable discrete nodules are scattered throughout both lungs, best demonstrated in the upper two-thirds of the lung fields.

Two cases we have encountered are presented to illustrate two different syndromes of the same disease.

CASE REPORTS

CASE I: On the morning of Sept. 10, 1957, a 38-year-old farmer climbed the enclosed ladderway to the top of a silo to level the silage which had been blown in on the previous day. Although the silage blower was in operation, he detected a bitter, stinging odor in the chute. On descending the chute, he experienced the same sensation, which became more pronounced as he made his way down. About 9 feet from the bottom, he was overcome by the fumes and fell to the floor of the silo room. His brother carried him outside, where he immediately revived. He was short of breath, coughed considerably, and was nauseated but did not vomit. Weakness was

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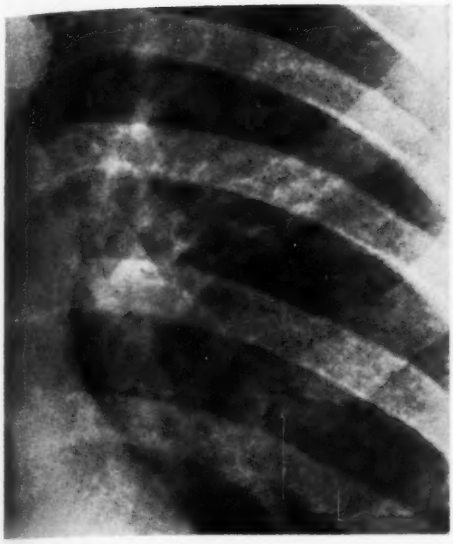

Fig. 1A. Detail of Fig. 1.

pronounced. By evening he felt well enough to help with chores, but weakness and slight cough persisted. Inspection of the chute three hours after exposure revealed an orange haze.

Ten days after exposure, the patient visited his physician, complaining of cough, left earache, weakness, and shortness of breath. Examination revealed left otitis media and early sinusitis. Antibiotics were prescribed. He continued to cough, however, and blood streaking of the sputum was noted. His wife, who was a trained nurse, found that he had a fever reaching a daily evening peak of 101 to 104° F.

Thirty-four days after exposure, the physician was again consulted, because of persistent cough, hemoptysis, and moderate left anterior chest pain. The temperature was 99° F. There were no physical signs in the chest. Antibiotics, rest, and cough medicine were prescribed. A chest roentgenogram revealed generalized fine nodulation in both lungs, most pronounced in the upper two-thirds (Fig. 1). When consultation with the referring physician revealed a typical history of exposure, the diagnosis was readily apparent.

Thirty-eight days after exposure, the patient was admitted to the hospital. He appeared subacutely ill. Respirations were rapid and labored. Temperature, pulse, and blood pressure were normal. Fine râles were present bilaterally. Hemoglobin was 12.5 gm., hematocrit 38 per cent, and total white blood cell count 6,800, with 74 per cent segmented cells and 26 per cent lymphocytes. The corrected erythrocyte sedimentation rate was 32 mm. in one hour. The tuberculin skin test was positive in forty-eight hours. Antibiotics, a sedative, and cough medicine were given. For the wheezing and dyspnea, which were worse at night, oxygen and a semi-upright position were of some benefit. During a six-day hospital stay, fever (100.6° F.) was present only on the evening of the second day. Sputum cultures for tuberculosis were negative. On the day before discharge (forty-three days after exposure), a chest film revealed slight resolution of the nodular densities.

Following discharge the patient was still weak

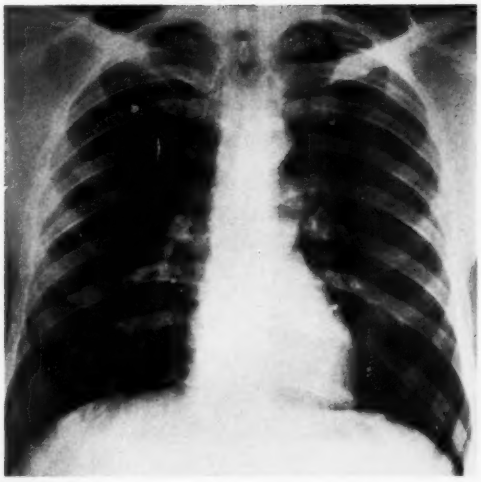

Fig. 2. Case I. One hundred twenty-six days after exposure. The nodules have disappeared.

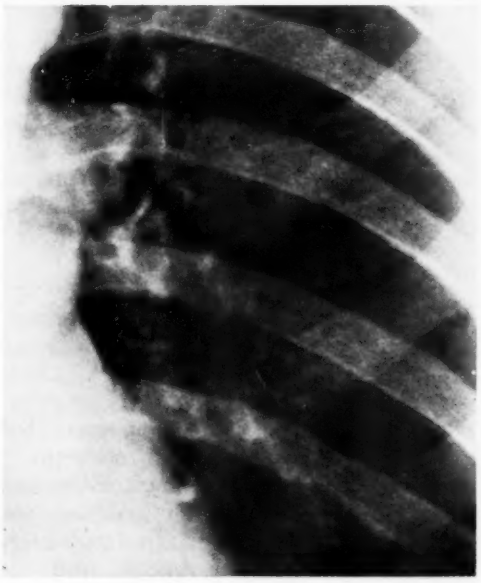

Fig. 2A. Detail of Fig. 2.

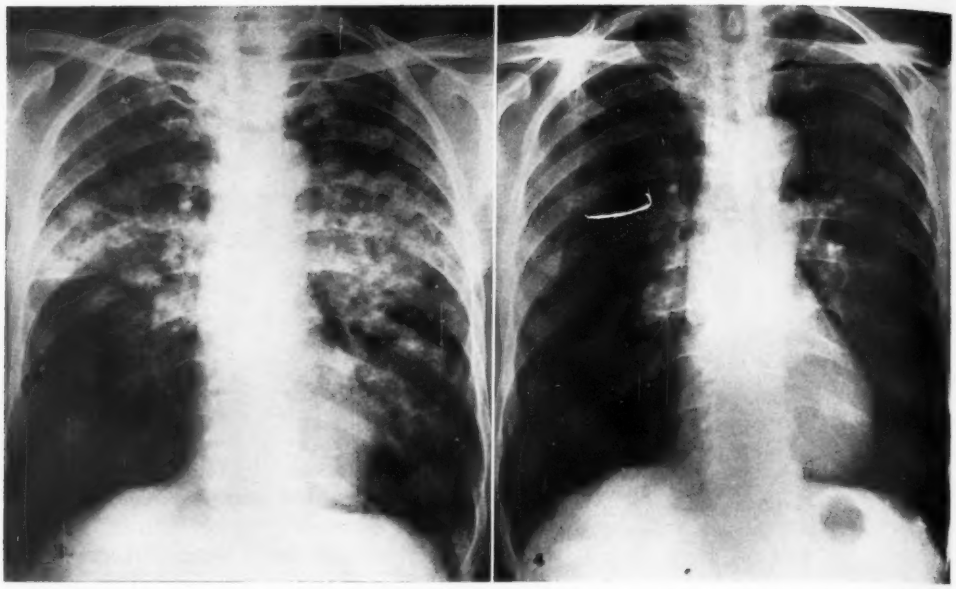

Fig. 3. Case II. Roentgenogram one day after exposure to silage fumes. Patchy infiltration in both lungs with confluence in the midportions.
Fig. 4. Case II. Fifteen days after exposure. The infiltrations have disappeared.

He continued to sleep in a semi-upright position, but the cough had disappeared. A roentgenogram fifty-three days post-exposure showed further clearing, and at four months the lung fields were normal (Fig. 2). Six months after exposure, he felt well but was able to do only light work. Exertion and exposure to cold air produced dyspnea.

Comment: The course of the disease in this instance was protracted, and at no time was the patient critically ill. Comparison with other cases with tissue proof, notably Eckhardt's case (8), suggests that this man had a subacute bronchopneumonia with bronchiolitis fibrosa obliterans. Although pulmonary function was apparently not yet normal six months after exposure, further observation and investigation will be necessary to determine if there is any permanent disability.

CASE II: On the morning of Sept. 11, 1956, while feeding cattle near the bottom of a silo which was partially filled with fresh corn silage, a 67-year-old farmer noticed a yellowish haze in the area, which was irritating to his nostrils. He soon felt weak and experienced generalized "aching." His symptoms became progressively worse during the day and he was unable to work after 4:00 P.M. Shortly after he retired that night, a severe cough developed, with much sputum, occasionally flecked with blood. The next morning he suffered dyspnea on the slightest exertion, chest pain on coughing, dizziness, and anorexia. These symptoms persisted throughout the acute phase of the disease.

On admission to the hospital, Sept. 12, temperature, pulse, and blood pressure were normal. Crackling and bubbling râles were present in both lungs. Breath sounds were distant. Physical examination was otherwise not remarkable. Hemoglobin was 15.4 gm., red blood cell count 5.5 million, and total white blood cell count 11,950, with 90 per cent neutrophils, 9 per cent lymphocytes, and 1 per cent monocytes. Sputum smears and cultures were negative for a predominating microorganism. A chest roentgenogram demonstrated patchy infiltration throughout most of the lungs, with confluence in the midportions (Fig. 3).

On the day of admission, the temperature rose to 99.6° F.; it varied between that figure and 101° F. for the next two days, and after the fourth hospital day was normal. Therapy consisted of 5 mg. of Metacortone every six hours and 500 mg. of Aureomycin every eight hours for eight days. There was rapid clinical improvement. A roentgenogram six days post-exposure revealed considerable resolution of the pneumonic process. Fifteen days after exposure, the infiltrations had disappeared (Fig. 4). The patient was discharged on the twentieth hospital day. Since that time he has had no specific chest complaints. Subsequent roentgenograms have revealed no residual or recurrent abnormality.

Comment: The clinical and roentgenographic features in this instance differ considerably from those of Case I. The major illness began within a few hours of exposure and became progressively worse over the next twenty-four hours, but within a week the patient was well on the way to recovery. The hormone therapy may have been of value, although a patient with a very similar early course also improved rapidly without steroids (10). This case has been classified as acute chemical bronchopneumonia.

ETIOLOGY

Only in recent years has production of nitrogen dioxide in fresh silage been recognized as a serious and potentially lethal hazard. The first conclusive lead came in September 1949, when Dr. William Peterson of the University of Wisconsin obtained strongly positive tests for nitrites and nitrates on a sample of silage from a silo in which a farmer had been almost overcome by fumes (18). Confirmation was soon obtained in tests on a university farm silo.

In April 1956, Delaney and associates (6) reported 2 cases of pulmonary disease following exposure to fresh silage. Because of Peterson's analyses of gases arising from fresh silage and because of the clinical similarity to cases following exposure to nitrous fumes from burning roentgen film (15), nitrous fumes were held responsible. Shortly thereafter, Lowry and Schuman (14) reported 4 examples of bronchiolitis fibrosa obliterans (with necropsy proof in 2), apparently due to the same cause.

Stimulated by the serious nature of the hazard, Peterson and associates (19, 22) carried out more extensive tests in 1956. Five recently-filled silos all gave a positive test for nitrogen dioxide. In one instance a gas sample taken from a silo drain-pipe, eighteen hours after the silo had been filled, showed up to 10,000 times the allowable industrial concentration of 10 to 25 parts per million.

Analyses of experimental lots of silage have revealed some interesting features of nitrous fume production (2, 19, 20, 23). Nitric oxide (NO) is the chief gas produced. Nitrogen dioxide, the deadly gas, is not found in the silage, but forms when nitric oxide comes in contact with the oxygen of the air (23). Gas production reaches a peak within twenty-four hours and seems to be over in two or three days (20). Much more nitric oxide is produced by alfalfa than by corn silage. Nitric oxide is a colorless gas. Nitrogen dioxide is reddish-brown in color; being heavier than air, it seeks the lowest available level.

PATHOGENESIS

Injury results from local effect of the nitrous fumes on the bronchopulmonary tissue (16). The degree of injury depends primarily on the intensity and duration of exposure and secondarily on individual sensitivity (12, 17, 24).

Mild exposure produces a catarrhal inflammation extending down to the smallest bronchioles (5). More intense exposure results in loss of bronchiolar epithelium, with fibrinous bronchiolar and peribronchiolar inflammation. Acute death from pulmonary edema is due to severe injury to the bronchiolar, alveolar, and capillary walls. With marked bronchiolar damage, granulation tissue grows into the fibrinous bronchiolar exudate, resulting in bronchiolitis fibrosa obliterans. Alveolar atelectasis or emphysema may result (1).

PATHOLOGY

The following pathologic changes have been noted in silo-filler's disease: pulmonary edema (6, 11); bronchopneumonia (6, 11); bronchiolitis fibrosa obliterans (8, 14); focal interstitial fibrosis (8). Those patients dying of pulmonary edema also showed microscopic evidence of early bronchopneumonia. In some patients with the acute form of the disease, however, the illness was less severe and the clinical and laboratory findings suggested that the bronchopneumonia predominated.

In the cases of bronchiolitis fibrosa obliterans, the lungs were diffusely involved by innumerable small, discrete, grossly

palpable nodules resembling the nodules of miliary tuberculosis. On microscopic study, fibrin plugs were noted in the bronchioles, with a variable degree of organization. At an early stage, there was a crescentic remnant of the lumen. Later the lumen was obliterated and the bronchiolar and peribronchiolar tissues were converted into an area of proliferating granulation tissue. In one case (8), lung biopsy seven months after exposure showed marked improvement compared to the findings on biopsy fifty-two days after exposure. The bronchiolar lumina were distorted but not occluded. Mild focal interstitial fibrosis was present.

CLINICAL FEATURES

Almost all patients noted the immediate irritative effect of the gas. After the initial symptoms, two main clinical groups were apparent among the total of 14 cases: immediate and delayed. In the 4 cases in the former group, severe illness developed within a few hours of exposure, ending in death in 2 cases of pulmonary edema and rapid recovery in 2 cases of acute bronchopneumonia. There were 8 cases in the delayed group; 6 were classified as bronchiolitis fibrosa obliterans, 1 as bronchiolitis, and 1 as subacute bronchopneumonia. The typical illness in the delayed group was triphasic, consisting of early morbidity, variable remission, and relapse thirteen to thirty-three days after exposure. There was a spectrum of disability in this group ranging from fatal bronchiolitis fibrosa obliterans (2 cases) to subacute bronchopneumonia, probably due to variable degrees of bronchopulmonary injury. Two cases were not classified. One patient (21), who received multiple fume exposures over a two-month period, had a chronic progressive form of the disease. Another (13), two and one-half years after exposure, was a respiratory cripple due to diffuse obstructive emphysema.

ROENTGENOGRAPHIC FEATURES

In one case of pulmonary edema extensive bilateral infiltration (6) was observed. Two cases of acute bronchopneumonia showed patchy confluent areas of infiltration chiefly in the mid lung fields. Resolution was rapid and complete, paralleling the clinical course.

The roentgenographic findings in 6 cases of bronchiolitis obliterans were reviewed. The best series of films was obtained by Eckhardt. In his case, clinical relapse began at thirteen days, but a roentgenogram at seventeen days revealed only minimal nodulation in the right base. Thereafter, the nodulation spread diffusely through the lungs, paralleling the progressive clinical course. In the other cases, films made at the height of relapse exhibited miliary nodulation. Roentgenographic resolution began about the fortieth day and tended to lag behind clinical improvement. In 2 cases treated with steroids, tiny nodules were still evident four and six months later, respectively. In 2 cases not treated with steroids, nodules were not evident four and nine months later, but in 1 of these there was biopsy proof of pulmonary fibrosis. Thus, the roentgenographic findings did not give an accurate picture of the pulmonary status. In this connection, the case reported by Leib (13) is of interest. Roentgenograms two and one-half years after exposure disclosed no significant signs, yet severe obstructive emphysema, probably at the bronchiolar level, was present.

In keeping with the clinical course, the pulmonary mottling resolved earlier in the single case of subacute bronchopneumonia (6) than in the cases of bronchiolitis obliterans.

One patient received multiple fume exposures over a two-month period. Three and one-half months after the last exposure, there was a generalized fine reticulonodular pattern in both lungs. With prolonged steroid therapy, the nodularity disappeared but the interstitial fibrosis persisted.

DIFFERENTIAL DIAGNOSIS

The roentgen features of the disease are variable and not peculiar to it. Final diagnosis therefore depends upon their

correlation with other information. Ideally, chemical analysis of the silage gas should be carried out, but gas composition would be altered by the time the delayed cases presented themselves. Usually, the typical history of exposure followed by a clear-cut clinical and roentgenographic sequence makes this unnecessary.

The acute cases (pulmonary edema or acute pneumonia) may be indistinguishable clinically and roentgenographically from farmer's lung (7). Diagnosis is based on the date of silo-filling and absence of an unusual gas. In farmer's lung, the patient has been exposed to very moldy silage when a silo, filled some time in the past, is opened for the first time.

Diagnosis may be more difficult in the delayed cases. Awareness of the possibility is the crux of the matter. Many cases at the time of relapse were initially erroneously diagnosed as bacterial pneumonia because of chills and fever, cough, sputum, and râles in the chest. The chest roentgenogram may be normal early in relapse (9). At the height of relapse, the miliary pattern may present a problem in diagnosis for the radiologist.

Miliary tuberculosis has frequently been considered, chiefly because of the similar roentgen appearance. In bronchiolitis obliterans, however, there is a typical history of exposure, the respiratory distress is more profound, and tubercle bacilli cannot be isolated.

Bronchiolitis fibrosa obliterans is differentiated from acute disseminated histoplasmosis by the history of fume exposure, greater clinical severity, smaller nodules, and absence of hilar adenopathy (4). Metastasis and pneumoconiosis are readily excluded by nonroentgenologic means.

Two cases of silo-filler's disease exhibited no definite roentgen signs. The diagnosis was based on the history (9, 13).

TREATMENT

Oxygen and bed rest are indicated in all active cases with respiratory insufficiency. Antibiotics are of prophylactic value.

Six of the total of 14 cases reviewed were treated with adrenal cortical hormone. It seemed to be of little value in those patients with pulmonary edema or acute pneumonia. In the delayed cases treated in the relapse phase, however, there was dramatic clinical improvement and accelerated roentgenographic regression. Furthermore, these patients recovered completely and soon returned to work, whereas some of those with bronchiolitis obliterans who did not receive steroids were limited in their physical activity for many months.

PREVENTION

As a result of the wide publicity given to the discoveries at the agricultural colleges, most farmers are aware of the hazard of silo-filler's disease, but they are still too casual in observing the recommended precautions (3, 22). These involve adequate silo ventilation and avoidance of silos where a yellowish-brown haze is evident or an irritating odor is detected. Serious pulmonary injury can be produced, however, with only minimal irritative symptoms. Furthermore, once the irritation is detected, the damage has already been done. The simplest and safest solution is to *stay out of the silo* for at least seven to ten days after filling, with no exceptions for any reason whatever (14, 20).

SUMMARY AND CONCLUSIONS

1. Two additional cases of silo-filler's disease are reported and 12 others are reviewed.

2. A history of exposure to an irritating gas arising from fresh silage is the most important single fact in diagnosis.

3. If the clinician is aware of the disease, and of the possible syndromes it may present, the diagnosis is readily made.

4. Roentgenographic features are not diagnostic. However, when they are correlated with the history, the radiologist should be able to give a definite etiologic and pathologic diagnosis.

5. Two groups of cases are recognized: those in which severe illness develops immediately after exposure and those in

which early morbidity is followed by remission, which in turn is succeeded by relapse.

6. In the delayed group in relapse, roentgenographic changes may lag behind the clinical cycle.

7. Pulmonary fibrosis and obstructive emphysema are possible complications in the delayed cases. Accurate evaluation requires pulmonary function tests and, possibly, lung biopsy.

8. Adrenal cortical hormone has been of definite value in the delayed cases.

NOTE: We express our thanks to Dr. D. L. Minter of Clinton, Wisc., for supplying the clinical data in Case I.

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SUMMARIO IN INTERLINGUA

Morbo de Cargator de Silo

Es reportate duo casos de morbo de cargator de silo. Dece-duo alteres es revistate. Es apparente duo major gruppos clinic: (1) Le casos in que sever grados de maladia se disveloppa immediatemente post le exposition e (2) le casos in que un morbiditate immediate es sequite per un remission de duo o tres septimanas, con recidiva subsequente.

Un historia de exposition al irritante gas de silage fresc es le plus importante facto individual pro le diagnose. Le aspectos roentgenographic, ben que non specificamente diagnostic, es de adjuta quando illos es correlationate con le historia del patiente. In le gruppo con remission e recidiva, le alterationes roentgenographic se retarda frequentemente in comparation con le cyclo clinic. Fibrosis pulmonar e emphysema obstructive es complicationes possibile in le casos retardate. Le accurate evalutation require tests del function pulmonar e, possibilemente, biopsia pulmonar. Hormon adrenocortical se ha monstrate de definite valor in le casos retardate.

Further Studies on the Accuracy of Oral Cholecystography[1]

HILLIER L. BAKER, JR., M.D., and JOHN R. HODGSON, M.D.

IN A RECENT communication (1), we discussed the degree of accuracy with which the presence or absence of pathologic changes in the gallbladder could be predicted by means of oral cholecystography. In that study all surgically proved cholecystographic diagnoses at the Mayo Clinic in 1950 and 1955 were analyzed. These two years were chosen because of the different cholecystographic media employed: iodoalphionic acid (Priodax) in 1950 and iodophenoxic acid (Teridax) in 1955.

In 1956, about midyear, we again changed our medium, and by September all patients were receiving iopanoic acid (Telepaque). This study is a summary of results in the first full year (1957) in which this drug was used.

PROCEDURE OF ORAL CHOLECYSTOGRAPHY

In this and in our previous study (1), we reviewed some 3,600 cholecystograms obtained in 1950, 1955, and 1957, and were impressed by the fact that the accuracy of the diagnosis seemed to have little relationship to the medium employed for the roentgen study. We are now firmly convinced that correct technical conduct of the examination, and continued vigilance and interest on the part of the radiologist and technician in this phase of the procedure, are indispensable if uniformly accurate results are to be expected.

Scant attention has been paid to the actual technic of cholecystography in the literature of the past quarter century. For this reason we wish to recount, in some detail, the procedures which we employ.

Preliminary Preparation of the Patient: Each patient is instructed to take four 0.5-gm. tablets of iopanoic acid during or shortly after an evening meal of the usual size, from which eggs and fats have been omitted. He eats nothing from then until after the x-ray examination has been made the next day, although he may drink water, black coffee, or clear tea. He is further advised not to take a laxative.

It will be noted that the medium is ingested at a time when the stomach contains food. This, we believe, reduces to a minimum gastric irritation and unpleasant gastrointestinal side-effects attributable to the drug. After some trial of a high-fat meal on the evening preceding examination, we have concluded that more consistent results are obtained if fatty foods are eliminated from this meal.

Roentgenographic Technic: The patient reports for examination approximately fourteen to sixteen hours after ingesting the medium; he is placed on the table in an easy posture with the head turned to one side. The arms are brought upward in a comfortable position, and a pillow is put under the ankles so that no weight is borne by the toes. A wide canvas binder is then firmly applied across the back at the level of the lower ribs. All of these procedures are designed to eliminate motion which may obscure roentgen evidence of stones or tumors.

Two or three films of the right upper quadrant are now obtained by means of a rotating anode tube with a 1-mm. focal spot and 2-mm. aluminum filter. The tube is equipped with a small round cone (bottom opening 3 inches in diameter) which exposes a circular area, 6 1/2 inches in diameter, on the film placed 36 inches from the target. This device reduces the amount of scattered radiation and increases the clarity of the roentgenogram. A flat 12 to 1 Potter-Bucky grid further enhances detail. The roentgenographic formula is proportioned to the patient's thickness as determined by measurement. Although

[1] From the Mayo Clinic and Mayo Foundation (Section of Roentgenology). The Mayo Foundation, Rochester, Minn., is a part of the Graduate School of the University of Minnesota. Accepted for publication in February 1959.

the kilovoltage and exposure time are varied, 150 ma are employed on all exposures. A thin patient (14 cm. thick) would require an exposure of two-tenths of a second and 65 kv, whereas a stout patient (34 cm. thick) would need an exposure of five-tenths of a second and 112 kv. To minimize motion, the shortest exposure time consistent with adequate penetration of the rays is chosen in all cases, and the exposure is made with respirations suspended at the end of a normal expiration.

We employ DuPont-Patterson Par Speed intensifying screens and Kodak Blue Brand film. All roentgenograms are developed with Kodak rapid developer. This combination yields films of high diagnostic quality more consistently than any other we have tried. We have recently experimented with high-speed screens (Radelin and DuPont-Patterson) and Kodak Royal Blue film in the hope of further reduction of exposure time and consequent elimination of motion. The finished roentgenograms, however, showed excessive graininess which caused unsharpness of the image. In many cases the size of the grains approached that of exceedingly tiny stones within the gallbladder and increased the difficulty of interpretation. We have therefore, for the time being, abandoned this avenue of investigation.

When the preliminary roentgenograms have been processed, they are scrutinized by the technician to determine if the gallbladder is visible and has been well depicted on the films. If so, the patient drinks 6 oz. of 20 per cent cream to stimulate emptying of the gallbladder, and 45 to 60 minutes later two to four additional exposures are made. The examination is then terminated.

Positioning of the Patient: Many conflicting shadows may obscure the medium filled gallbladder and because of this a variety of positions may be employed to afford the radiologist an unobstructed view of that organ. The following positions and views are among those used: (*a*) prone, (*b*) right lateral decubital, (*c*) oblique, (*d*) upright, (*e*) Trendelenburg, (*f*) inspiration-expiration view, and (*g*) tomographic views. The prone and lateral decubital positions provide adequately diagnostic films in about 95 per cent of the cases and the latter has proved so satisfactory that we are at present exploring the possibility of eliminating the routine prone view altogether. The oblique view is utilized in those cases in which the gallbladder lies far medially and is projected over the spinal column. The upright view is useful in demonstrating shifting of a small filling defect when the lateral decubital view has failed to clarify the differential diagnosis between calculus and cholesterol polyp. The Trendelenburg position is employed for the same purpose if the gallbladder becomes obscured by intestinal contents with the patient upright. In addition, a gallbladder lying low in the pelvis may be rendered completely visible in this position. The inspiration-expiration views are usually reserved for those cases in which an overlying rib obscures a portion of the gallbladder. If none of these simpler maneuvers offer successful results in demonstrating the suspected pathologic state, tomography may be used to good advantage. The wide canvas binder, previously mentioned, must be loosened momentarily as each new position is assumed, in order to permit rearrangement of the abdominal organs. In this way full benefit may be derived from the change in posture.

By the use of these multiple positions, when and as indicated, the diagnostic reliability of cholecystography has attained a high degree of perfection in our experience. We differ with those proponents of upright compression spot-film roentgenography of the gallbladder who state that no cholecystographic examination is complete without such views and that diagnostic accuracy is greatly increased by their use. Although the rapidity with which the examination is completed may be increased by the spot-film method, we prefer to train an intelligent technician, who is interested in producing superior cholecystograms, in the use of

conventional technics, rather than to expose both the patient and radiologist to the hazard of additional ionizing radiation. This is especially true in view of the superior diagnostic results.

Useful Technical Adjuncts: For many years it has been of some concern to us that re-examinations were necessary in about 10 per cent of our patients because residual gas and fecal material in the bowel prevented satisfactory diagnosis. About a year prior to this study a new drug, dihydroxyphenylisatin, a purgative which acts directly on the large intestine, became available, and its use has helped eliminate 60 to 70 per cent of the re-examinations. Because it exerts its effect by contact with the mucosa, the drug is administered as an enema (10 mg. dissolved in 1 1/2 quarts of warm water). Care must be taken to place the patient on his right side after administration, so that the hepatic flexure will be affected. Side-effects such as cramping and faintness are usually mild but may be severe; for this reason the drug is not used if the patient is elderly or debilitated. Our employment of dihydroxyphenylisatin has increased steadily since its introduction and to us the benefit from its use are self-evident.

Several different types of radiolucent plastic foam blocks useful in a variety of radiologic applications have been placed on the market in the past few years. A small block 6 × 6 × 3 inches may be placed under the gallbladder area prior to tightening the canvas binder and will afford some compression of this region. We have found that this maneuver is particularly useful in the displacement of gas-filled loops of bowel or in permitting a reduction in the exposure time in very obese patients. Further studies are being made in this field.

Recently a purified form of the hormone, cholecystokinin, which causes the gallbladder to contract by direct action on the muscular walls, has been utilized as a possible substitute for the Boyden meal. Because the product must be administered intravenously, it is not applicable to large groups of patients. If a more easily usable form becomes available, it should permit the performance of gastrointestinal studies on the same day as cholecystography without the necessity of foregoing the so-called postcontraction film. This in our opinion has great value in the radiologic examination of the gallbladder.

We make no claim that the technic of cholecystographic study described here is original with us, as we have borrowed widely and to advantage many procedures devised by others. We present it not only to illustrate a method which has yielded good results but also to emphasize again that their excellence is directly proportional to the care exercised in the conduct of the examination.

MATERIALS AND METHODS

In order to discover the degree of accuracy of cholecystographic diagnoses in the year 1957, the operative and pathologic findings of all surgically treated patients on whom cholecystograms had been obtained were correlated with the roentgen diagnoses. There were 1,207 patients available for this study.

All roentgenograms were reviewed and re-interpreted by us without knowledge of the original preoperative diagnosis or of the operative findings. In assessing accuracy, the preoperative diagnoses were, of course, used in all cases; our independent diagnoses were employed only as an aid in the analysis of errors. In addition, the technical quality of the film was assessed and the reasons for any deficiency in this respect were tabulated. Finally, the density of the medium in each functioning gallbladder was estimated and characterized as being slightly, moderately, or markedly greater than that of the adjacent hepatic shadow.

For the purposes of determining the correctness of the roentgenologic data, any of the following findings were considered to be in error: (*a*) a gallbladder called "normally functioning" but found to be inflamed in any degree, or to contain stones; (*b*) a gallbladder called "poorly

TABLE I: SUMMARY OF DATA FOR 1957

Diagnosis, 1957	No. of Cases	Findings at Operation: Gallstones	Tumors	Chronic Cholecystitis: Slight Thickening	Chronic Cholecystitis: Moderate Thickening, Subacute	Chronic Cholecystitis: Marked Thickening, Acute	Miscellaneous	Normal	Diagnosis Confirmed at Operation (per cent)
Gallbladder									
Normally functioning	353	3	..	2	1	..	..	347	98.3
Poorly functioning	3	1	..	2	..	..	..	..	100.0
Nonfunctioning	229	188	6	3	2	4	21	5	97.8
Normally functioning with stones (474) / Poorly functioning with stones (37) / Nonfunctioning with stones (100)	611	599	6	1	..	..	..	5	98.0
Tumors	11	..	11	.	.	.	..	..	100.0
TOTALS	1207	791	23	8	3	4	21	357	..

Cases with positive cholecystographic data, 854; errors, 17 (98.0 per cent correct). Of 1,207 diagnoses, 1,184 (98.1 per cent) confirmed.

Cases with gallstones at operation, 791; positive cholecystographic data in 788 (99.6 per cent). Gallstones were visualized and reported in 599 (75.7 per cent) of the 791 cases.

Cases with disease of gallbladder at operation, 850; positive cholecystographic data in 844 (99.3 per cent).

Cases without disease of gallbladder at operation, 357; negative data in 347 (97.2 per cent).

TABLE II: ACCURACY OF DIAGNOSIS (PER CENT)

Diagnosis	Medium Used: 1950 Iodoalphionic Acid (Priodax)	1955 Iodophenoxic Acid (Teridax)	1957 Iopanoic Acid (Telepaque)
Gallbladder			
Normally functioning	93.8	94.8	98.3
Poorly functioning	90.9	...	100.0
Nonfunctioning	96.7	97.2	97.8
With stones	99.1	99.1	98.0
Tumors	100.0	100.0	100.0

functioning" or "nonfunctioning" but found to be normal; (*c*) a gallbladder said to contain stones or a tumor but found to be without them.

FINDINGS AND COMMENT

On the basis of the stated criteria, operation and pathologic examination revealed that only 1.9 per cent of the 1,207 diagnoses in 1957 were in error (Table I).

Although this rate of error is somewhat lower than the rates found in our previous series (2.7 and 2.4 per cent), a comparison of the complete data in all three studies reveals that the reduction was achieved as a result of substantial improvement of diagnostic accuracy in those cases falling into the categories of normally functioning and poorly functioning gallbladder, and in spite of a diminution in accuracy when the presence of stones was indicated (Table II). To us the improvement shown in the former categories is encouraging and indicates that the errors deemed "avoidable" in our previous study are, in fact, being avoided. Those errors, almost a third of the total, were attributed either to faulty observation or faulty interpretation.

The use of iopanoic acid did not materially increase the percentage of gallbladders that exhibited some degree of function, the percentage being 72.8 with iopanoic acid and 72.1 with iodophenoxic acid. There was, however, a definite increase in the number of gallbladders with marked concentrations of medium (Fig. 1). This dense opacification made minute mucosal details more frequently visible, but their faulty interpretation led to a slight increase in the erroneous diagnosis of cholelithiasis. Comments on this problem will be made subsequently.

Normal Function: The diagnosis, "normally functioning gallbladder," has proved erroneous more frequently than any other

single cholecystographic diagnosis. We found (1) that many fallacious diagnoses were unavoidable because certain diseased gallbladders maintained their function sufficiently to produce a normal shadow or contained minute calculi (less than 4 mm. in diameter) which are usually radiographically undetectable by present methods. Other errors, such as rendering a diagnosis when the films were obviously of poor quality or overlooking small stones within the gallbladder, especially in the region of the cystic duct, were due to lapses on the part of the interpreter and were thought to be avoidable.

Of 353 so-called normally functioning gallbladders 1.7 per cent showed definite pathologic alteration. All of these errors were of the unavoidable type: 3 gallbladders contained minute calculi described as "sand" by the pathologist, and 3 showed moderate inflammatory changes in their walls but did not contain stones. It would appear, therefore, that with our present methods we cannot expect to reduce the diagnostic error much below 2 per cent in this group.

Poor Function: We have always considered the diagnosis of poorly functioning gallbladder to be unsatisfactory, since it represents a negative approach to the evaluation of cholecystic disease. It indicates, in effect, that the gallbladder cannot be called "normal" and therefore must be considered abnormal even though no specific abnormality can be discerned. With the vast improvement of cholecystographic media in the past few years we have resorted to this diagnosis less and less. In the 1,207 cases in this series it was made only 3 times.

In 1950, when our cholecystographic medium was iodoalphionic acid, about a third of the normal gallbladders concentrated the medium only faintly, and the diagnosis of poorly functioning gallbladder

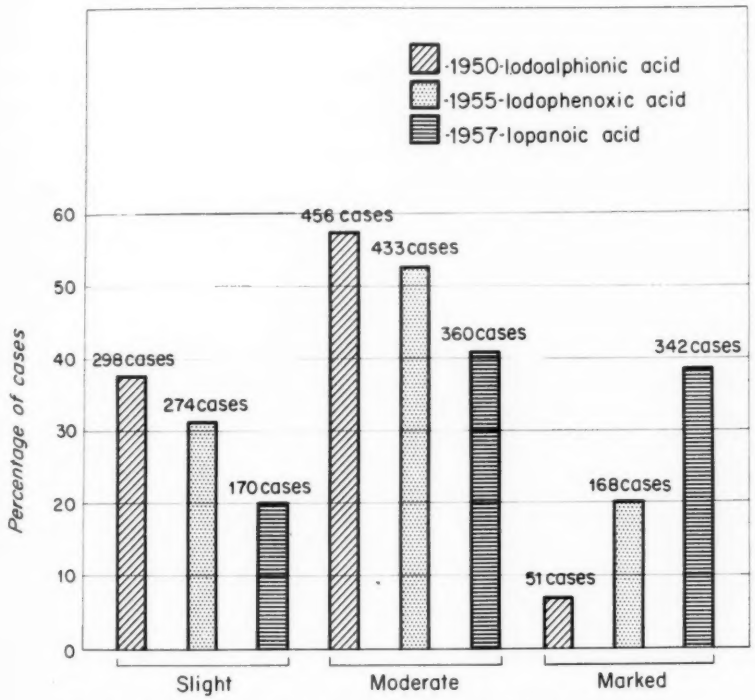

Fig. 1. Degree of increased density as compared with density of liver.

was made 22 times. In 2 of these 22 patients the gallbladder was found to be normal, a diagnostic error of 10 per cent.

Because of the increased iodine content of iodophenoxic acid employed in 1955, only 23 per cent of the normal gallbladders in that year showed faint shadows. As a consequence the interpreters probably attributed a dim shadow to complete lack of function and no diagnoses of poor function were made.

Iopanoic acid, the medium now in use, is concentrated by the gallbladder even more markedly than the other media. Less than 10 per cent of the normal organs can be said to cast faint cholecystographic shadows, and even these are of fair density. Occasionally, however, a faint outline may be encountered which would justify the diagnosis of poor function. Only rarely, in such an event, is disease of the gallbladder not found. Pathologic changes were present in all of our cases.

Nonfunction: Two per cent of all so-called nonfunctioning gallbladders were found to be normal. We agreed with the preoperative diagnosis in all 5 of these cases and could find no explanation for the failure of the gallbladder to concentrate the medium. The proportion of errors in this group was virtually identical to that observed in our previous study and to us it represents the minimal error which can be expected.

Cholelithiasis and Tumors: We are convinced that the diagnosis of benign tumors of the gallbladder should become commoner in the future because denser cholecystographic media have enabled us to perceive small mucosal excrescences which previously were not visible. When the classic finding (single or multiple small *fixed* filling defects within the outline of the opacified gallbladder) was seen, the diagnosis of polyp proved correct in all of our cases. The findings were atypical in 2 cases: In 1, several polyps had become detached from the mucosa and could be seen to move freely within the gallbladder; in the other, the gallbladder contained a single 8-mm. polyp which adsorbed the medium, and its periphery was thereby outlined with a denser shadow. The erroneous diagnosis of cholelithiasis was made in both these cases, unavoidably contributing to the decreased accuracy in that group. Four avoidable erroneous diagnoses of cholelithiasis were made when the interpreter failed to recognize that the small filling defects did not change position with relation to each other or the gallbladder and that they were in reality polyps.

Six of 12 errors in the group having stones were due to nonrecognition of polyps. The other 6 errors were attributable to various causes: 2 were deemed unavoidable in that the surgeon was unable to palpate small calcified stones through the wall of the gallbladder in patients who underwent surgical procedures for other reasons and in whom the gallbladder was not removed; 4 were due to errors in interpretation and, since our diagnoses differed from the original, these errors were thought to be avoidable.

SUMMARY AND CONCLUSIONS

In a series of 1,207 cholecystographic examinations in which all diagnoses were subjected to surgical and pathologic verification, 1.9 per cent of all diagnoses were found to be in error.

The use of iopanoic acid did not materially influence the percentage of gallbladders that exhibited some degree of function, but it did increase the number of gallbladders observed with higher concentrations of medium. There was no evidence that this increased opacity of iopanoic acid obscured tiny calculi or rendered normally visible abnormal gallbladders which did not contain stones.

The diagnosis of normally functioning gallbladder was found to be correct in 98.3 per cent of such cases. This represented an improvement over our previous series and was attributable to improvement in both radiographic technic and interpretation.

All gallbladders called "poorly functioning" were found to be diseased. The in-

creased accuracy of this diagnosis seemed to have a direct relationship to the medium employed.

Stones were found in 98.0 per cent of the cases diagnosed preoperatively as cholelithiasis. This is a decrease in accuracy from previous series and resulted from misinterpretation of data made available as a result of the increased opacity of the medium.

Polyps, papillomas, or adenomas were found in all cases in which they were reported.

No change was observed in the incidence of normal gallbladders among the nonfunctioning group; 97.8 per cent of these organs were found to be diseased.

Mayo Clinic
Rochester, Minn.

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SUMMARIO IN INTERLINGUA

Studios Additional in Re le Accuratia de Cholecystographia Oral

Esseva analysate le examines cholecystographic effectuate in un serie de 1.207 patientes. In omne le casos le diagnoses roentgenologic habeva essite subjecte a verification chirurgic e pathologic. Esseva trovate que 1,9 pro cento del diagnoses esseva erronee. Le constatationes in iste serie, in que acido iopanoic (Telepaque) esseva usate, esseva comparate con duo previe series in que Priodax e Teridax esseva empleate.

Le uso de acido iopanoic non augmentava substantialmente le procentage del vesicas biliari exhibiente un certe grado de function sed illo de facto augmentava le numero del vesicas biliari observate con plus alte concentrationes de substantia de contrasto. Esseva notate nulle signo que iste augmentate opacitate de acido iopanoic obscurava calculos de micrissime dimensiones o resultava in un visualisation normal de non normal vesicas biliari que non contineva ulle calculos.

Esseva trovate que le diagnose de vesicas biliari a function normal esseva correcte in 98,3 pro cento de tal casos. Isto representava un melioration in comparation con le previe series e poteva esser attribuite a meliorationes tanto del technica radiographic como etiam del interpretation.

Esseva trovate que omne le vesicas biliari designate como "dysfunctional" esseva de facto morbide. Le augmentate accuratia de iste diagnose pareva esser directemente relationate al substantia de contrasto usate.

Calculos esseva trovate in 98,0 pro cento del casos in que un diagnose de cholelithiasis habeva essite establite ante le operation. Isto es un declino de accuratia in comparation con previe series e resultava ab le erronee interpretation del datos debite al augmentate opacitate del substantia de contrasto.

Polypos, papillomas, o adenomas esseva demonstrate in omne le casos in que illos habeva essite diagnosticate.

Esseva observate nulle alteration in le incidentia de vesicas biliari normal in le gruppo designate como "non functionante." Le procentage de iste organos in que morbiditate esseva demonstrate amontava a 97,8.

Reactions Associated with Intravenous Urography: Discussion of Mechanisms and Therapy[1]

EUGENE A. HILDRETH, M.D., HENRY P. PENDERGRASS, M.D., RODERICK L. TONDREAU, M.D., and DAVID I. RITCHIE, M.D.

IN A PREVIOUS communication (21), historical evidence was presented demonstrating that the use of iodide compounds for intravenous urography is increasing rapidly. In 1956, approximately 1,368,000 intravenous urographic examinations were performed in the United States alone, which is a fivefold increase in fourteen years. Serious reactions, even though uncommon, have become generally recognized hazards in urography.

If the incidence of fatal reactions associated with intravenous urography between 1942 and 1952 is compared with the period between 1952 and 1956, the difference is not statistically significant. It is noteworthy, however, that fatal reactions during the last three years show an upward trend which may be indicative of their increasing occurrence (21). In any event, there is no doubt that, coincident with the greater use of intravenous urography, more fatal as well as nonfatal reactions are being reported each year.

The procedure of intravenous urography is a necessary adjunct to the practice of clinical medicine. Effort must be directed, therefore, toward understanding the mechanisms of these reactions and their prophylaxis and therapy. In the following communication, an attempt is made to present what we think is the best available information. In addition to what is known, much ignorance must also, of necessity, be laid bare.

CLINICAL PICTURE

The clinical picture of reactions associated with intravenous urography is varied. Some types of reaction predominate, however, and a grouping on a clinical basis has thus become possible.

TABLE I: SYMPTOMS AND SIGNS REPORTED IN 102 FATAL UROGRAPHIC REACTIONS

Dyspnea	75%
Shock	63%
Cyanosis	50%
Frothy sputum and questionable pulmonary edema	22%
Respiratory arrest	14%
Convulsions	12%
Nausea and vomiting	10%
Asthma	10%
Flush	8%
Cardiac arrest	6%
Arrhythmia*	2%

* All patients had pre-existing heart disease.

I. Such signs and symptoms as pain in the arm, phlebitis, nausea, flushing, giddiness, tingling, numbness, and cough seem to be related to mild toxicity or in some cases to apprehension. They will not be discussed further.

II. Symptoms that are probably unrelated to toxicity or pharmacological action, and that may be allergic in nature, may be mild or severe:

(*a*) *Mild: Immediate* onset of urticaria or conjunctivitis, with or without rhinitis, developing within minutes of the injection.
Delayed exanthematous or urticarial eruptions, usually appearing hours after the injection.

(*b*) *Severe:* In this category are the reactions that endanger life.

The most severe reactions include several of the symptoms listed in Table I. Certainly the most common manifestations in a series of 102 immediate fatal reactions following urography (1930–56) recorded in previous communications (19-21) were dyspnea, shock, cyanosis, pulmonary edema, convulsions, asthma, and retching. The terminal event was most often described as respiratory arrest, cardiac arrest,

[1] From the Departments of Medicine and Radiology, University of Pennsylvania, Philadelphia 4, Penna. Accepted for publication in March 1959.

or "collapse." In all probability, the chief cause of convulsions was anoxia, since they occurred only in those patients who were dyspneic or cyanotic.

It is significant that about 75 per cent of the reported fatal reactions presented primarily as respiratory distress; 21 per cent as severe circulatory collapse. Moreover, in 31 per cent of the 76 patients whose reactions began with acute dyspnea, shock subsequently developed as well. Laryngeal edema was rare.

Caution should be exercised in the interpretation of the above statistics, since in most instances the data from which they were derived were obtained in retrospect. Nonetheless, the clinical pictures are quite clear.

MECHANISM OF FATAL OR NEAR-FATAL UROGRAPHIC REACTIONS

The exact mechanism or mechanisms of these reactions are not proved. Enough is known, however, to suggest an hypothesis. At least three possible causes of reactions to organic iodine contrast media may be operative: toxicity, pharmacological idiosyncrasy, and allergy.

Toxicity: This word implies that a substance, acting directly through its inherent chemical properties, and by its ordinary action, is capable of destroying life or seriously endangering health when administered in moderate doses (30).

The toxicity of iodides in man and the animals tested is similar to that of the closely related chemicals: chlorides and bromides. The immediate toxicity is low even with intravenous injections (9, 31, 36). In dogs, 8 c.c. of 25 per cent solution per kilogram intravenously (equivalent to 0.2 gm. of sodium iodide per kilogram) causes no difficulty (31). This dose is far in excess of that used in any intravenous contrast study in man, particularly in urography. Larger doses in dogs (0.8 gm. of sodium iodide per kilogram of body weight) produced a delayed toxic effect. In twelve to thirty-six hours after the drug is given, nervousness, peripheral edema, and death due to central paralysis may occur.

The organic iodine water-soluble compounds used in urography are excreted rapidly, almost entirely *via* the kidney, without liberating iodide ions. Theoretically, therefore, toxicity following ordinary dosage should be negligible.

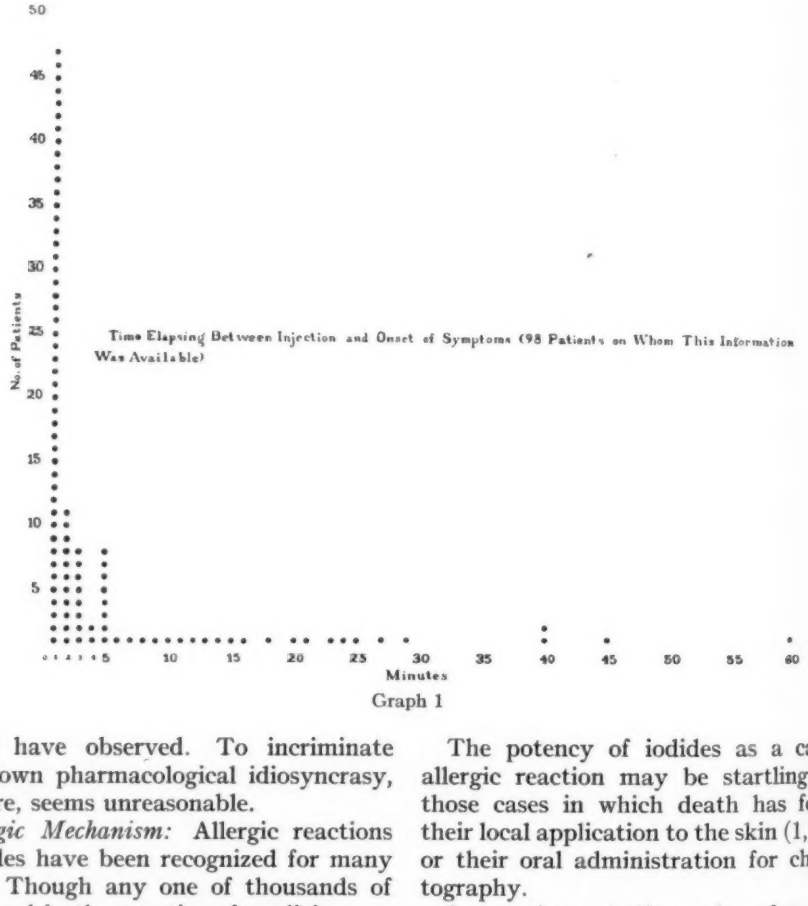
In man, the most concentrated form of iodine administration is that used in angiography, where the usual dose is 40 to 50 c.c. of 70 per cent iodopyracet, or approximately 0.5 to 1.0 c.c. of a 70 per cent solution per kilogram of body weight. This is several times greater than the dose used in urography. Thus, if toxicity were the important factor in all urographic reactions, it would seem reasonable to expect a higher percentage of reactions to angiography. While it is true that reactions to angiography are more common than to urography, the difference in incidence is not as great as one might expect if iodine toxicity alone were concerned. This statement is true if fatalities occurring in patients with cyanotic heart disease are excluded and the dosage is considered on a body weight basis (5, 8).

In addition, it is obvious that, in at least some cases, toxicity is not a factor. There are instances of fatal or near-fatal immediate reactions following intracutaneous injection of as little as 0.1 c.c. of the medium, as well as after conjunctival tests, intravenous introduction of 1.0 c.c., oral administration for cholecystography, and aspiration for bronchography (3, 15, 21, 26, 32, 33).

On the basis of rather extensive data accumulated in animals and man, it would seem unlikely that toxicity is the major factor in causing severe reactions during urographic examinations. The exceptions, where toxicity seemed to play a critical role, have been observed chiefly in children who had received doses that were very large for their body size, and in patients otherwise severely ill.

Pharmacological Idiosyncrasy: Pharmacological idiosyncrasy is defined as an exaggeration of known pharmacological effects, indicative of abnormally high individual susceptibility to the action of the drug.

The commonly recognized pharmacological effects of iodides in man are salivation, expectoration, and a metallic taste in the mouth. Iodism is also seen, but its mechanism is uncertain (9, 31). None of these effects is evident in the protocols of the 102 patients who died of immediate reactions during urography. Nor are these effects commonly noted in the much more numerous nonfatal reactions that we personally have observed. To incriminate any known pharmacological idiosyncrasy, therefore, seems unreasonable.



Graph 1

Allergic Mechanism: Allergic reactions to iodides have been recognized for many years. Though any one of thousands of drugs used in the practice of medicine can act as an allergen, the vast majority of drug reactions are due to a few relatively potent allergens. In this notorious group (1) are the iodides. Experimentally, they have been shown to combine with protein readily and thus have the potential to develop hapten systems (13, 14).

Iodides have produced many types of allergic reaction. No less than a dozen varieties of skin eruptions have been attributed to this cause, such as urticaria, purpura, exfoliation, etc. (1, 22). Systemic allergic reactions have also been many and varied, including acute nephritis, thrombocytopenic purpura, periarteritis nodosa, Loeffler's syndrome, asthma, and anaphylactic shock (1, 12).

The potency of iodides as a cause of allergic reaction may be startling, as in those cases in which death has followed their local application to the skin (1, 18, 25) or their oral administration for cholecystography.

In previous studies, when fewer data were available, the clinical picture of the immediate severe reactions to contrast media containing organic iodine was not as well understood as now. In the 102 fatal reactions the protocols of which have been studied, the signs and symptoms (Table I) are clinically identical with symptoms seen

TABLE II: FACTORS THAT MAY HAVE CONTRIBUTED TO DEATH IN THE REPORTED PATIENTS (1952–56 SERIES)

	Patients
Cardiac and/or vascular disease	25
Uremia	8
Central nervous system disease	3
Toxicity (overdosage)	2
Emphysema	2
Jaundice due to liver disease	2
Premature infant	1
Multiple congenital defects	1

in severe reactions due to a variety of other drugs (1).

Graph I shows the time elapsing between intravenous administration of iodine and onset of fatal anaphylaxis in the 1952–56 series (21). It is clear that the interval is very short. These data are of the same type as those for patients who suffer anaphylactic shock from drugs such as penicillin or during hyposensitization by pollen (allergenic) extracts (4, 27).

From the foregoing discussion, it must be concluded that, while proof of the mechanism of reactions occurring during intravenous urography is lacking, the available evidence strongly suggests allergy as the chief cause. Other factors, particularly cardiovascular disease, renal failure, severe liver disease, disease of the central nervous system, and debilitation from any cause, may undoubtedly play contributory roles (Table II).

AN APPROACH TO PREVENTION OF REACTIONS

One must realize that at present we lack the means to predict accurately which patient will react adversely to the iodides. A careful consideration of the clinical history, with emphasis upon allergy, remains the *sine qua non* in this field (Table III). In the individual case it must be decided whether the indications for the procedure are cogent enough to warrant the minimal risk of a fatal reaction. Moreover, urography should be performed only if there is a reasonable chance of visualizing the urinary tract, *i.e.*, where marked impairment of renal function does not foredoom the attempt to failure.

It is generally felt that a past history or family history of allergy may increase the chances of difficulty (1, 6, 17, 21). That our own data do not support this opinion may be due in part to the fact that we have avoided urography in the allergic subject whenever possible. In the absence of statistical proof, such a history is considered as a warning but is not used by itself as an absolute contraindication. The past history should, of course, be specifically checked for previous reaction to iodine compounds, as this information may be of critical importance.

Alexander has written: "The reliability of skin tests is debatable" (2). On the basis of our own data and those of others (17, 34), we feel that this sentence could be changed to read: "Immediate wheal and erythema skin tests (reaginic type) are worthless in predicting reactions to the iodides now being used in contrast study." And this is true in the vast majority of drug reactions, regardless of the agent.

Since allergy testing based on the immediate wheal and erythema reaginic type of reaction is of no value, we suggest that, prior to a proposed study, one should test the patient by observing his tolerance for a small dose of the medium to be used. This seems reasonable, since reactions are of all degrees of severity, as illustrated by the fact that certain patients have reacted violently to small test doses and survived. It seems logical to suppose that, had a full dose been given, the reaction would have been much more severe. A negative result of such preliminary studies will not, however, screen out all individuals susceptible to reaction, as some patients who have failed to react to small test doses have suffered a fatal reaction to a full urographic dose (19–21).

We feel, therefore, that it is at present impossible for anyone to prescribe an experimentally proved method of testing for reactions associated with urography. With this in mind, it is our purpose to evaluate the following program from the experimental standpoint, in the hope that it may possibly be of value or lead to new technics that may help prevent reactions to the

TABLE III: PRELIMINARY DATA IN USE OF CONTRAST MEDIUM

Name _____ Male Female Date _____

File No. _____ Age _____

Clinical Diagnosis _____

_____

Thyroid Function being tested Yes _____ No _____

Contrast medium to be used _____

1. *Personal History* of Asthma _____ Hay Fever _____

   Food Induced Rashes _____ Excessive Sneezing _____

   Hives _____ Drug Reactions _____

   Any Previous Iodine Medications or Studies _____

   When _____ Dye Used _____ Reaction _____

2. *Family History* of each above (including siblings, parents, aunts, uncles, and grandparents)

   _____

3. *Dosage Testing* (not an allergy type of skin test):

Reactions	Subcutaneous 0.1–0.2 c.c. (1:10) Medium (Twelve to Twenty-four Hours Before Urography)	I.V. 1.0 c.c. Medium (One to Five Minutes Before Urography)
Flushing		
Skin rash		
Local swelling		
Nausea		
Resp. distress		
Fainting or shock		
Others		
Delayed reactions		

Radiologist _____ M.D.

organic iodine contrast media so necessary to the proper practice of medicine.

EXPERIMENTAL PLAN

(1) Approximately twelve to twenty-four hours prior to the urographic examination, 0.1–0.2 c.c. of the preparation to be used (dilution 1:10) is injected subcutaneously. This is designed as a very small test dose; it is not an allergy skin test. An extremity is preferred as the site of injection since, if a severe reaction should occur, a tourniquet can be placed proximally, delaying venous and lymphatic drainage. The patient is instructed to report any local reaction, eruption, etc., and is specifically questioned as to these prior to the next step (Table III).

(2) At the time of the urographic examination, 1.0 c.c. of the contrast medium is injected intravenously, following which there should be a wait of at least one minute, and preferably longer, before the final injection is made.

(3) The dosage for the examination should be the least amount necessary (21). This sounds axiomatic, but it appears that, particularly in children, doses in excess of those needed for urographic study have been used. Because of our experience in finding that contrast media given rapidly for angiography and slowly for urography are similar in their effects, we are unprepared to recommend a slow rate of administration. If the physician in charge is concerned about the use of a contrast medium in a given patient, he should probably not rely on slow administration for safety.

(4) If careful clinical evaluation suggests the possibility of untoward reactions, the intravenous test dose could be administered, with a three-way stopcock system connected to an intravenous infusion of 5 per cent glucose and water. Thus, when 1.0 c.c. of the contrast medium is to be given as a test dose, the patency of the needle can be maintained by a switch to a very slow infusion, the total volume of which can be negligible. In such an instance, there should be a wait of at least five minutes—preferably fifteen to twenty—before the final urographic injection. If a reaction should occur, the open intravenous infusion may be invaluable for administration of drugs and fluids.

If the likelihood of reaction seems great, the patient should be hospitalized and consideration given to using either 0.5–1.0 c.c. of epinephrine, 1:500 in oil, fifteen to thirty minutes prior to the intravenous test dose, or hydrocortisone, 200–300 mg., by mouth, three to four hours before the test dose, or both. If hydrocortisone is necessary and time permits, 100 mg. every six hours might be administered for at least twenty-four to forty-eight hours before the urogram is obtained, with the radiological study being performed three to four hours after a given dose.

(5) It has been reported that 10 mg. of chlorprophenpyridamine (an antihistamine) administered several minutes prior to the intravenous contrast medium reduces minor reactions from 17.3 to 7.1 per cent (29). Other evidence (6, 16, 33, 34), however, indicates that this may not be so, and antihistamines are of little benefit in preventing or treating the more serious, potentially fatal reactions. Thus, we do not use antihistamines prophylactically. Certainly their use in epileptics should be avoided, for seizures can thus be induced.

(6) Following actual administration of the contrast medium, we keep the patient under close observation for at least fifteen to thirty minutes. At the first sign of a reaction, vigorous therapy is instituted. Every minute is of critical importance.

THERAPY OF REACTIONS

Despite everything that can be done by both the referring physician and the radiologist, occasional severe reactions will occur. For the potentially fatal reaction, preparations must be made to put an emergency plan into action at once by prearranged regimen and signal. Since therapy may vary in some respects, depending on the clinical picture presented, each pattern of reaction will be discussed separately.

1. *Dyspnea, Wheezing, Cyanosis, With or Without Shock:*

(*a*) *Epinephrine:* On the basis of data accumulated in our recent survey, we have revised our attitude toward the use of epinephrine in the immediate type of urographic reaction (20). We now believe it to be usually, if not always, the drug of choice, since most such reactions are probably allergic in origin.

Aqueous epinephrine, HCl, 1:1000, 0.5 c.c., is given immediately, intramuscularly if the patient is under observation and if complete vascular collapse has not occurred. To hasten absorption, the site of injection may be massaged. If shock prevents absorption, half the dose should be given very slowly, intravenously. Administration should be repeated every ten

to fifteen minutes as needed. Improvement following the first dose has been reported in a few cases, with subsequent relapse and death when treatment was not repeated.

As a rule, cyanosis seems to be due to pulmonary involvement. This is best reversed by epinephrine. Also, convulsions are probably most often associated with cyanosis and due to anoxia. In patients with hypertension or coronary artery disease, there may be some concern about the use of epinephrine. Clinical experience, however, has shown that even in these patients, the drug can be employed to combat anaphylaxis without significant harm (4).

(*b*) *Adequate oxygenation and airway* is provided by the proper positioning of the head and, if necessary, insertion of an oral airway through which the patient can breathe or receive artificial respiration. Oxygen is administered in the presence of cyanosis and to patients particularly susceptible to anoxia, such as those with coronary artery disease. These and other methods of maintaining oxygenation in coma are described elsewhere (7, 10, 24, 35).

If the patient is asthmatic or dyspneic without shock, it is probably best to raise his head on several pillows. When shock without orthopnea is present, he should be placed in shock position (Trendelenburg, with legs elevated). If shock develops simultaneously, epinephrine may well control it. However, vasopressors may be necessary. Moderately strong vasopressors that can be given intravenously or intramuscularly are methoxamine hydrochloride (5 to 10 mg.) and phenylephrine hydrochloride (0.5 mg.). If prompt recovery does not ensue, the more potent l-nor epinephrine (levarterenol bitartrate) should be used—at least 4 to 8 ml. diluted in 500 ml. of 5 per cent glucose and water. The rate of administration, intravenously, is dictated by blood pressure response.

2. *Asthma or Pulmonary Edema:* Two additional drugs, extremely valuable, though slower in taking effect than epinephrine, are aminophylline, 0.5 gm., given intravenously over five to twenty minutes, and prednisolone 21-phosphate, 40 mg. given intravenously in ten to twenty seconds.

3. *Total Vascular Collapse and Coma (Alone).*

(*a*) *Epinephrine:* See above.

(*b*) *Shock position.*

(*c*) *Vasopressors* should be started at once. If a tourniquet is put on the arm the instant trouble begins, a vein can often be kept sufficiently distended with blood to permit easy needle puncture for intravenous therapy.

(*d*) *Adequate oxygenation,* as described above.

(*e*) *Prednisolone 21-phosphate:* See above.

(*f*) *Additional therapy* as indicated, if the immediate emergency passes and other symptoms manifest themselves.

4. *Convulsions* and other signs of central nervous system involvement are best avoided by preventing anoxia through maintaining oxygenation and blood pressure. For convulsions that are not due to anoxia, barbiturates are helpful. In the presence of cyanosis, however, they would do harm by further depressing the central nervous system.

5. *Laryngeal edema* either in the presence or absence of "spasm" is rare. It is best treated by epinephrine, with or without tracheotomy. It is probable that the latter will not be needed if epinephrine is given at the first sign of trouble.

OTHER TYPES OF THERAPY

1. *Cortisone-like drugs* are of no value in the first and most critical minutes of an anaphylactic reaction. Even if one gives prednisolone 21-phosphate intravenously in a matter of seconds, the full effect does not develop for fifteen minutes to several hours, which may be much too late. However, if the reaction is severe, after epinephrine, airway maintenance, and/or vasopressors are in use, 40 mg. of prednisolone intravenously can be of real value in the long-range aspects of therapy (1, 28).

2. *Cardiac massage and artificial respiration* have been resorted to in order to save life in a number of instances of anaphylaxis. How widely thoracotomy and cardiac massage can be applied by those other than surgeons is something for the future to decide. Simpler methods for the treatment of cardiac arrest that may be tried first are blows to the heart through the chest wall, cardiac stimulation by injection, and rocking the patient's knees against his chest at a rate of 60 times per minute (11, 23).

It must be remembered that, after four minutes of cardiac arrest, thrombosis of cerebral vessels and anoxia probably cause irreversible brain damage. Therefore, decisions must be made and put into effect rapidly.

3. *Respiratory stimulants and calcium therapy* have not proved of value; we no longer use them.

SUMMARY

The incidence of fatal and nonfatal reactions to intravenous urographic contrast media is rising in relation to the increased use of this valuable diagnostic technic.

The mechanism of fatal and other serious reactions is not completely clear. The best available evidence, however, strongly suggests that allergy is the most important single factor. Other factors that contribute to serious reactions are discussed.

A program for preventing such reactions, and treating them once they occur, is outlined for evaluation. No proof is offered that it will be effective in preventing fatal reactions, and the discussion is not to be interpreted as indicating that these measures are essential in iodine contrast studies. Many studies are necessary before a program can be formulated that will provide complete safety for the patient in need of urographic examination.

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SUMMARIO IN INTERLINGUA

Reactiones Associate con Urographia Intravenose: Discussion de Mechanismos e Therapia

Le incidentia de mortal e non-mortal reactiones al substantias de contrasto usate in urographia intravenose monta in relation al crescente frequentia del uso de iste utile technica diagnostic.

Le mechanismo del reactiones mortal e alteremente grave non es completemente clar. Le melior datos usque nunc accumulate suggere fortemente que le plus importante factor individual es probabilemente de natura allergic. Altere agentes que contribue a grave reactiones es discutite.

Le prevention de tal reactiones es considerate, e appropriate mesuras es proponite pro cata modo de reaction, i.e. (1) dyspnea, stertor, cyanosis, con o sin choc, (2) asthma o edema pulmonar, (3) total collapso vascular e coma (sol), (4) convulsiones, (5) edema laryngee. In plus, drogas cortisonoide, massage cardiac, respiration artificial, stimulantes del respiration, e therapia a calcium es considerate.

Le programma presentate in le articulo es presentate con le proponimento que illo deberea esser evalutate. Il existe nulle prova que illo va esser efficace in le prevention de reactiones mortal. Iste e multe altere studios debe esser effectuate ante que un methodologia pote esser prescribite que establi un securitate complete pro le patiente.

Influence of Cable Length on Dose Rate and Half-Value Layer in Diagnostic X-Ray Procedures[1]

E. DALE TROUT, B.S., D.Sc., JOHN P. KELLEY, B.S., and ARTHUR C. LUCAS, B.S.

INTEREST IN the patient dose incurred in diagnostic fluoroscopy and radiography, together with a tendency toward certain changes in technic and equipment, led to the belief that some investigation into the effect of these changes on the patient dose was justified. The changes in mind are the tendency toward reduced tube current and higher voltages in fluoroscopy and the use of tube-supporting structures requiring longer shock-proof cables between the x-ray tube and the high-voltage generator.

The assumption is often made that a reduction in tube current will bring about a directly proportional reduction in patient dose. This assumption may not be valid at the low currents used in fluoroscopic procedures, since the electrical capacity of shock-proof cables acts as a filter, having a tendency to alter the waveform to the x-ray tube in the direction of constant potential, an effect which is related to the length of the cable, the tube current, and the kilovoltage used. Even before the use of shock-proof cables, Taylor, in a paper published in 1933, pointed out that the capacitance of the then current aerial systems had a bearing on waveform and dose rate. The purpose of this discussion is to report the results of a study made in an effort to relate patient dose to these factors.

EQUIPMENT

The equipment used for the study was a full-wave rectifying unit rated at a maximum voltage of 130 kvp and a maximum current of 500 ma. A high-voltage rotating anode tube of similar ratings was used. From regular catalogue listings, four sets of cables were selected, with single cable lengths of 15, 24, 30, and 40 feet. It should be borne in mind that the total cable length involved in an installation is twice the length listed here. The nominal capacitance of the cable used was 65 micromicrofarads per foot.

Since some of the data presented here were dependent upon tube current, the milliammeter in the control was carefully checked against a milliammeter placed in the high-voltage circuit near the x-ray tube. The two systems were found to agree within 1 per cent at currents greater than 1 ma, the minimum tube current used.

KILOVOLTAGE CALIBRATION

In a study such as this, one of the questions that always arises is the accuracy of the voltage calibration of the x-ray machine under the actual conditions of installation and use. Calibrations adequate for routine fluoroscopy and radiography may not be sufficiently exact for laboratory studies. Modern equipment design makes it difficult to check kilovoltage by means of the usual sphere-gap calibrations. Even when sphere gaps can be connected into the circuits, there is the difficulty in getting accurate readings at high tube currents where short times must be used. The system proposed by Newell and Henny was considered, but it was not adopted because it requires a sphere-gap calibration to establish the base line.

In a paper published in 1955, Greening discussed the problem and proposed a method of calibration which seemed to lend itself to our needs. The method consists in determining the machine setting at which the K series fluorescence radiation from a secondary radiator just appears. The kilovoltage corresponding to the K absorption edge for the elements is a well established number, a convenient reference being the *Handbook of Chemistry and Physics*. The machine setting is determined by ionization methods not involv-

[1] Presented at the Forty-fifth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 15-20, 1959.

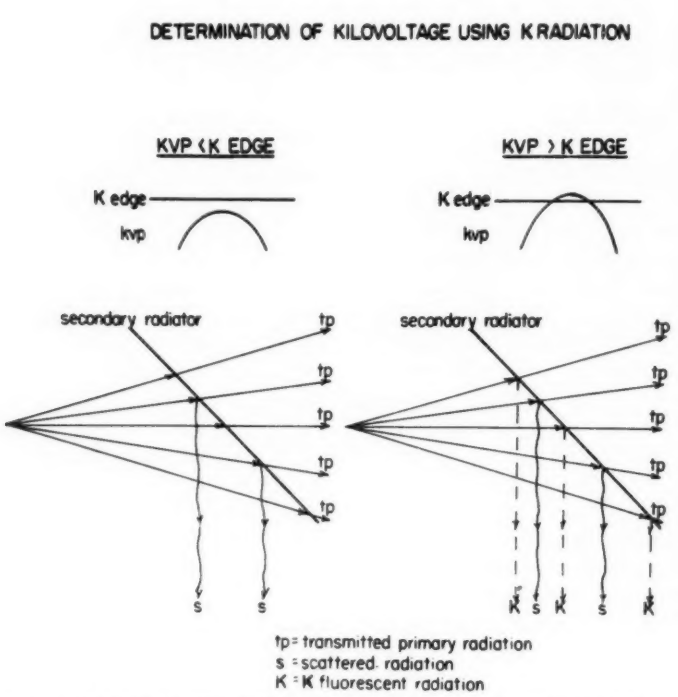

Fig. 1. Relation between peak kilovoltage, primary, and secondary radiation.

ing electrical connection to the generating system and without any limitation imposed by exposure time. Figure 1 illustrates the relation between peak kilovoltage, primary radiation, and secondary radiation. With peak kilovoltages less than the K absorption edge, the secondary radiation contains no K fluorescence radiation. As the peak kilovoltage is increased to a value slightly greater than the K absorption edge, K fluorescence radiation is added to the secondary radiation.

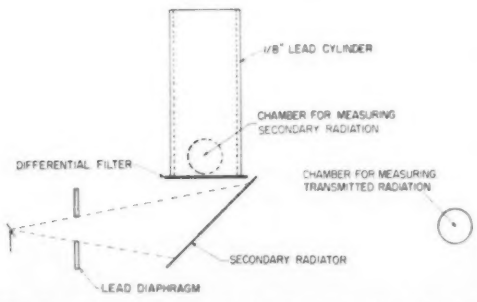

Fig. 2. Diagram of system for determination of peak kilovoltage.

Greening has shown that by measuring both the secondary radiation from an absorber and the primary radiation transmitted by it, the machine setting at which the K fluorescence radiation just appears may be determined. The arrangement of the secondary radiator and the ionization chambers is shown in Figure 2. The chamber used for measuring secondary radiation is shielded to ensure its receiving only secondary radiation from the absorber. A differential filter is placed at the face of the cylindrical shield to attenuate the lower energy radiation. Figure 3 is a photograph of our experimental set-up.

Figure 4(A) shows typical changes in dose rate of the secondary and transmitted radiation as the kilovoltage is increased up to and beyond the K absorption edge. It will be noted that there is a marked change in the rate at which secondary radiation increases with kilovoltage as the absorption edge is traversed. Greening pointed out that the most accurate method for locating the discontinuity is to

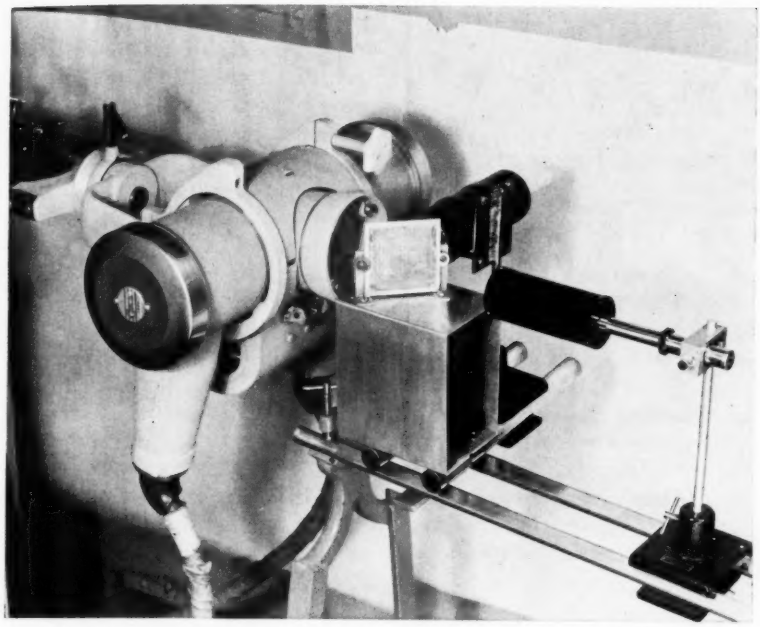

Fig. 3. Experimental arrangement for peak kilovoltage determinations.

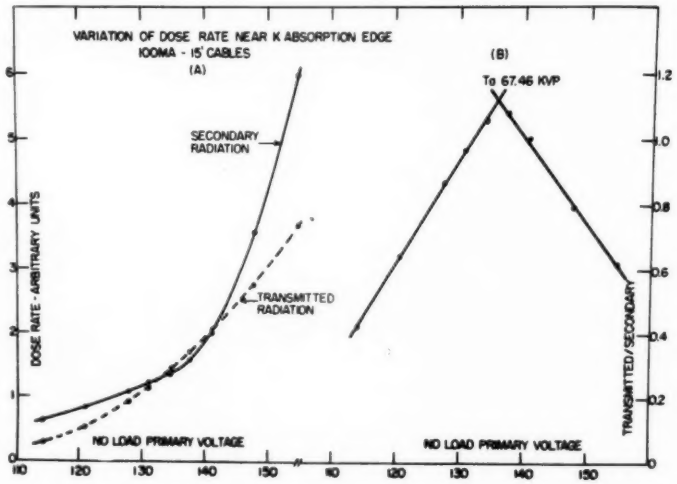

Fig. 4. A. Variation of dose rate near K absorption edge. B. Plot of transmitted/secondary radiation vs. no load primary voltage.

plot the ratio of transmitted radiation to secondary radiation. Such a plot for tantalum, which has a K absorption edge at 67.46 kev (kvp), is also shown in Figure 4(B). Two straight lines are fitted to the data and the point of intersection was taken by Greening as the machine setting which produces the kvp necessary to excite the K series fluorescence radiation. If such determinations are made with secondary radiators of several different elements, a plot of kvp as a function of machine setting may be obtained. Calibrations of this type made on several different

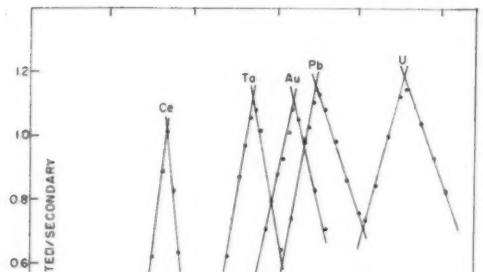

Fig. 5. Typical peak kilovoltage determinations.

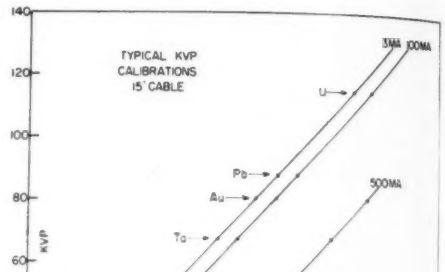

Fig. 6. Typical peak kilovoltage calibration.

TABLE I: CONSTANTS USED IN KVP CALIBRATION

Secondary Radiator	Kev (kvp)	Thickness of Secondary Radiator (mm.)	Differential Filter	Distance from Focal Spot to Chamber Measuring Transmitted Primary Radiation (cm.)
1	2	3	4	5
Cu	8.982	0.05	0.16 mm. Al	35
Mo	20.003	0.14	0.16 mm. Al	20
Ag	25.535	0.075	0.16 mm. Al	50
Sn	29.182	0.119	0.16 mm. Al	60
Ce	40.43	1.0	0.025 mm. Pb	60
Ta	67.46	0.28	0.05 mm. Pb	30
Au	80.67	0.27	0.075 mm. Pb	60
Pb	87.95	0.7	0.12 mm. Pb	50
U	115.0	0.5	1.0 mm. Cu	50

kinds of equipment have been found to be in good agreement with accurate sphere-gap calibrations.

Materials which have been used as absorbers and the energies of their K absorption edges are shown in Table I, columns 1 and 2. The thickness of the secondary radiator used (column 3) was, where possible, adjusted to yield a transmitted dose rate of the same order of magnitude as the secondary dose rate. In some cases (uranium, gold, and silver) this choice was further influenced by the thickness of material readily available.

The composition and thickness of the differential filter were determined by the following criteria:

(1) The differential filter must either be of the same atomic number as the secondary radiator, or it must be of some element not having an absorption edge in the region of the K edge of the secondary radiator.

(2) The differential filter must be of sufficient thickness to give a sharp peak but not so thick that the dose rate will be too low to be measured accurately.

The differential filters used are listed in column 4 of Table I. It will be noted that lead was used for most of the determinations. For the uranium determination, copper was used because the K edge of lead interfered with that of uranium to obscure the peak.

The distance from the focal spot to the chamber used to measure the transmitted primary radiation is shown in column 5. This distance was used as a final adjust-

ment of the dose rate at that chamber to produce readable discharges of the two chambers with simultaneous exposure. The distance from the secondary radiator to the front of the chamber measuring secondary radiation was 5 cm. in all cases.

Typical kvp determinations for the five calibration points used in these studies are shown in Figure 5 and the calibration derived from these five points is shown in Figure 6. The data in these two figures are plotted as a function of no load primary voltage. This was chosen as the most convenient parameter for our work, although kvp dial reading, kvp meter reading, autotransformer setting, or other parameter related to kvp could have been used as the independent variable.

Victoreen 0.25-r ionization chambers were used for the kvp calibrations necessary to these studies. It was found possible to perform such calibrations at currents as low as 1 ma and as high as 500 ma. At the higher currents it was necessary to fractionate the exposure in order to avoid exceeding tube ratings. For example, at the tantalum point (67.46 kev) the dose rate for each of the chambers was 150 mr/second at 500 ma, necessitating the use of five one-fifteenth-second exposures to obtain a reading of 50 mr.

Although the method for determining kvp was not the primary objective of this investigation, it may well prove to be the most significant contribution. As an example, the method was used, subsequent to these investigations, to calibrate a low-voltage microradiographic unit at voltages down to the 9 kev copper point. In some of our later work the method has been improved in sensitivity and reproducibility by the use of comparator technics such as those employed by Greening.

X-RAY OUTPUT WAVEFORM

While the effects of changes in cable length on current and voltage can be measured by conventional electrical technic, the effect upon dose rate is not readily determined from such data. In order to get a qualitative measure of this effect,

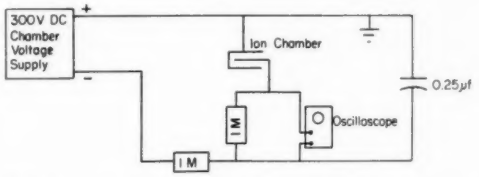

Fig. 7. Circuit used for determining x-ray output waveform.

an ionization chamber was connected to an oscilloscope through a short length of coaxial cable in the manner shown in Figure 7. Three hundred volts were found to be well beyond the chamber voltage required for saturation for tube currents up to 500 ma.

In order to reproduce faithfully the dose rate waveform from an ionization chamber with an oscilloscope, it is necessary to take several steps to minimize the time constant of the system.

(1) A short lead from the chamber to the oscilloscope must be used.
(2) The lead must be terminated in a relatively small resistance.
(3) A large chamber volume must be used in order to get high ionization currents to compensate for the small resistance.

The coaxial lead from the chamber to the oscilloscope was 5 feet long and the measuring resistor was 1.0 megohm in our system, with a resulting time constant of 0.1 millisecond. The volume of the ionization chamber was approximately 70 c.c. and it was used at a distance of 10 cm. from the focal spot.

An oscilloscope with a direct coupled vertical amplifier was used to preserve the D-C component of the waveform. Waveforms were photographed, enlarged, and traced to facilitate intercomparison.

X-ray output waveforms observed with this technic might be expected to fall somewhere between the two limiting cases represented by constant potential with no ripple and self-rectifying pulsating potential. Figure 8 shows a typical pulsating waveform obtained at high current, using short cables. It will be noted that the dose

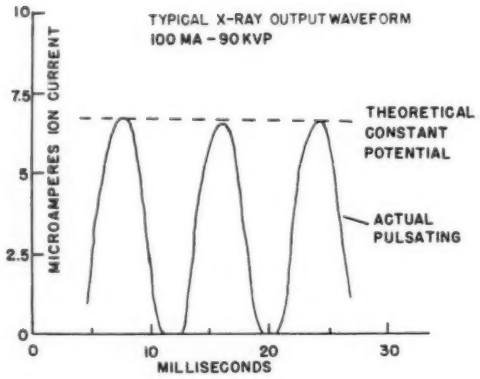

Fig. 8. Typical x-ray output waveforms.

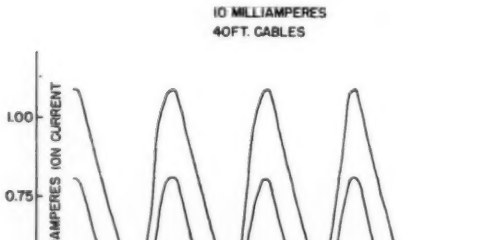

Fig. 9. Effect of kilovoltage on x-ray output waveform.

rate falls to zero after every impulse, in conformity with the usual concept of a pulsating generator.

Waveforms obtained at three kilovoltages with a 40-foot cable and a tube current of 10 ma are shown in Figure 9. The dose rate in no case falls to zero, and it would appear that, since the minimum dose rate observed on the 110-kvp trace is approximately coincident with the maximum dose rate observed on the 70-kvp waveform, the kilovoltage swing on the former is about 40 kv, that is, from 70 to 110 kv.

The effect of tube current on x-ray output

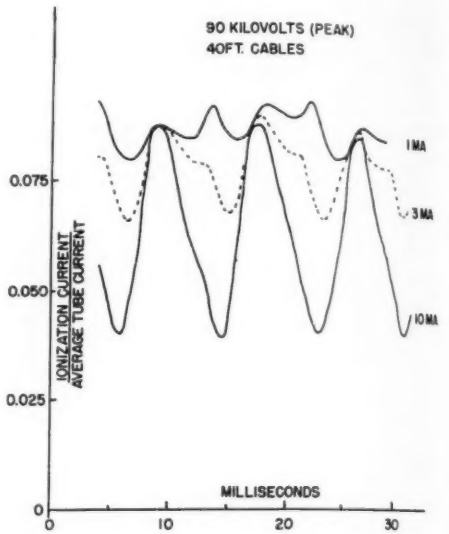

Fig. 10. Effect of tube current on x-ray output waveform.

waveform with 40-foot cables is shown in Figure 10. At low tube currents the output approaches that expected with constant potential apparatus, while the more rapid discharge of the cable capacitance at higher currents results in a greater ripple and, when carried to sufficiently high currents, will yield the pulsating waveform of Figure 9.

Cable length has a similar but opposite effect upon x-ray output waveform. Figure 11 shows the waveforms obtained with four different cable lengths at a fixed voltage and current. Longer cables, having greater electrical capacitance, yield x-ray output waveforms having less ripple than cables of shorter length.

These changes in waveform are sufficiently pronounced that it would seem that they could be easily observed in dose rate measurements and half-value layer determinations.

DOSE RATE

All dose rate measurements were made with a total filtration of 2.5 mm. Al, that is, 1.0 mm. in the tube wall and an added 1.5 mm. Measurements were made at a focal-chamber distance of 30 cm. or 12

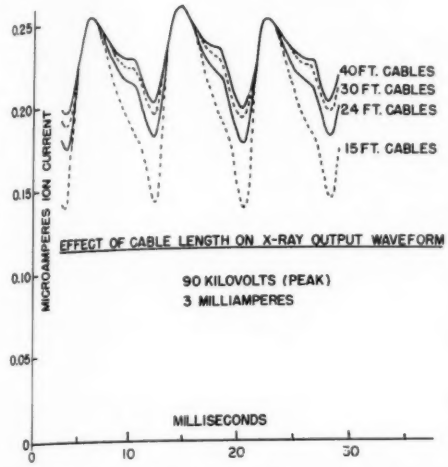

Fig. 11. Effect of cable length on x-ray output waveform.

inches, a convenient point from which to calculate dose rates at other distances.

Dose rates for three cable lengths at currents of 1 to 10 ma are shown in Figure 12. Separate kvp calibrations were made at each current for each cable length and the machine setting was used which gave 90 kvp according to the calibration previously described. Figure 12 demonstrates the necessity for actually measuring dose rates when evaluating patient dose. For example, it will be seen that at 5 ma, with a 30-foot cable, at 90 kvp, the dose rate is 6.9 r/min./ma or 34.5 r/min. If dose rate is assumed to decrease linearly with tube current, the assumption would be made that the dose rate at 2 ma would be two-fifths of 34.5 r/minute or 13.8 r/minute. Actually, the dose rate per milliampere will have risen from 6.9 r/min./ma to 8 r/min./ma, and the resulting dose rate will be 16 r/min., an error of 16 per cent. The possibility exists for two units operating at the same tube current and kilovoltage to yield dose rates differing by as much as 50 per cent as a result of differences in cable length. Large changes in tube current such as those encountered in performing the transition from the conventional fluoroscopic screen to some type

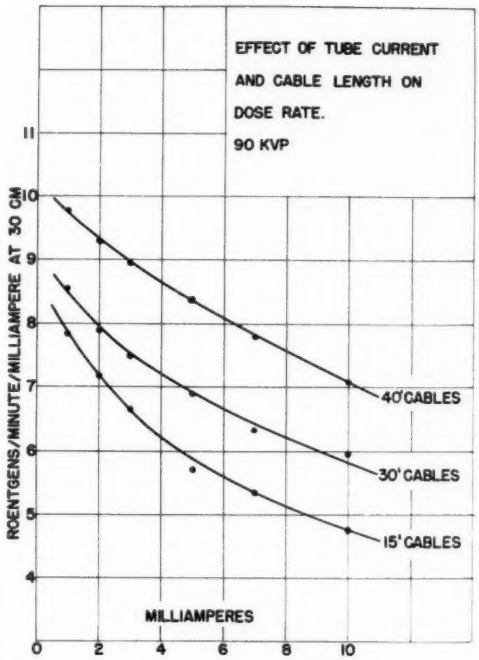

Fig. 12. Effect of tube current and cable length on dose rate.

TABLE II: TABLE TOP DOSE RATE
90 kvp; 2.5 mm. Al total filtration; 15-foot cables)

Focal-Table Top Distance (in.)	Tube Current 1	3	10 ma
	Roentgens per minute		
12	7.85	20.1	48
15	5.02	12.9	30.7
18	3.49	8.95	21.3

of image intensifier might well produce misleading results unless a new dose rate determination is made at the lower tube current. Table II shows the dose rates for a fluoroscopic installation having the minimum recommended filtration at three tube currents and three focal-table top distances at 90 kvp with 15-foot cables.

Figure 13 shows the dose rate per milliampere for several kilovoltages, cable lengths, and tube currents. It will be seen that the dose rate tends to become independent of cable length at very low tube currents or very high tube currents, since

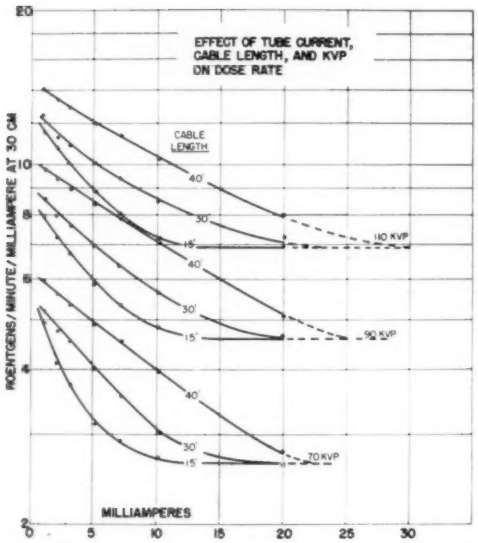

Fig. 13. Effect of tube current, cable length, and kilovoltage on dose rate.

HALF-VALUE LAYER

The change in half-value layer brought about by different cable lengths, tube currents, and kilovoltages was determined by taking data with two Victoreen rate meters in a comparator arrangement previously described. Narrow beam geometry was approximated by using a small aperture at the filter and a 70-cm. focal-chamber distance. The per cent transmission was measured through two filter thicknesses near the half-value layer and the half-value layer determined by interpolation.

The measured half-value layers for several kilovoltages, cable lengths, and tube currents are shown in Figure 14. It will be seen that the half-value layer changes follow the pattern that would be expected from an inspection of the dose rate and waveform studies.

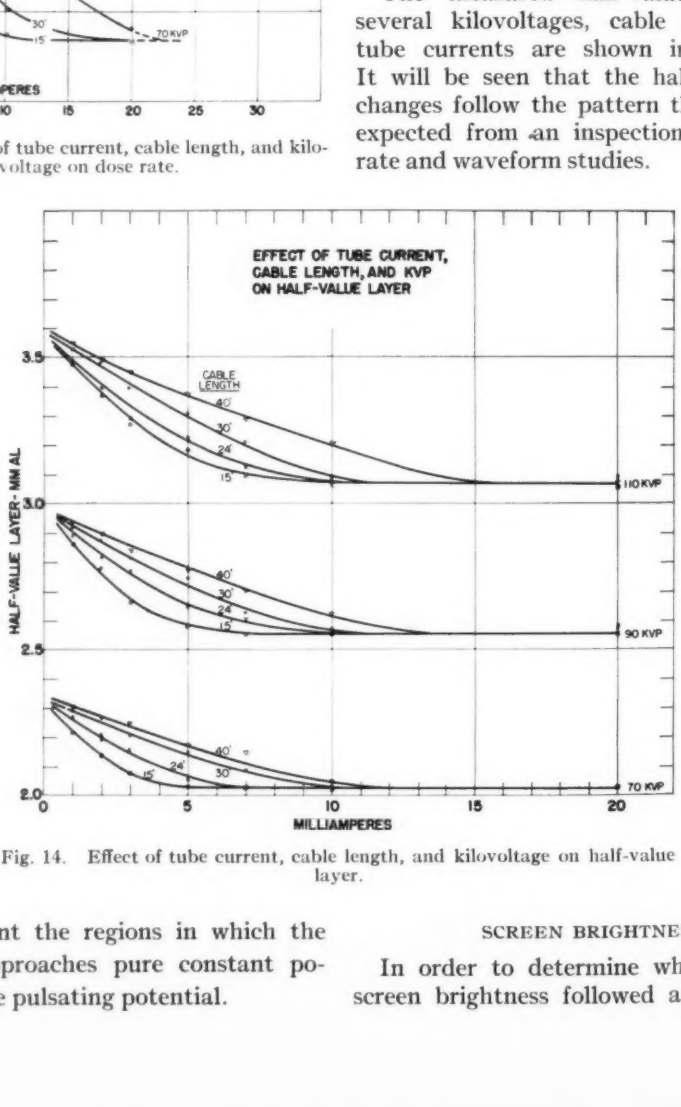

Fig. 14. Effect of tube current, cable length, and kilovoltage on half-value layer.

these represent the regions in which the waveform approaches pure constant potential or pure pulsating potential.

SCREEN BRIGHTNESS

In order to determine whether or not screen brightness followed a similar pat-

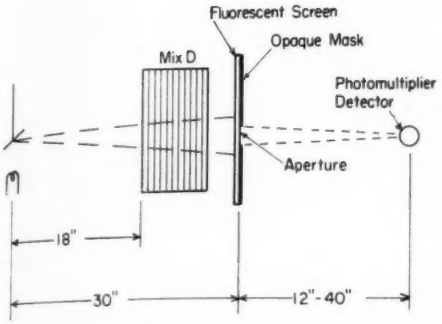

Fig. 15. System used for luminance determinations.

tern, a typical geometry was set up using a Mix-D phantom 20 cm. thick and a photomultiplier tube as a photometer, as shown in Figure 15. The linearity of the photomultiplier photometer was checked against a strontium-90 activated secondary standard light source and, on the basis of calibration data of the maker and an independent laboratory, was found to be linear to within 2 per cent. The fluoroscopic screen used was placed in a conventional fluoroscopic mounting between a thin sheet of Bakelite and a 1.5-mm. lead equivalent sheet of lead glass.

The resulting measurements, plotted as screen brightness per milliampere, are shown in Figure 16. They follow a pattern similar to that for dose rate, although the changes are more pronounced because of the added filtration introduced by the phantom material. Since screen brightness measurements were not made at currents greater than 10 ma, the data are extrapolated (dotted lines) to show the expected trend at higher tube currents.

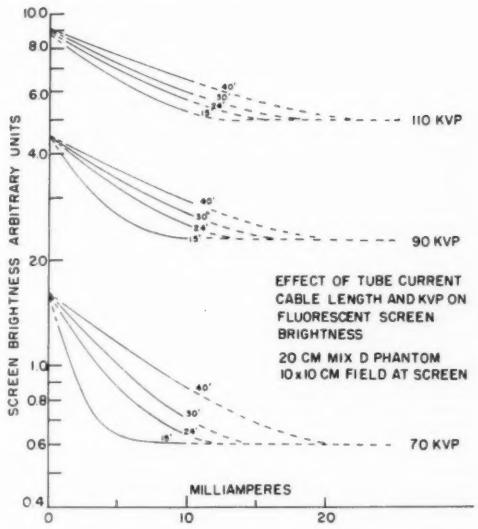

Fig. 16. Effect of tube current, cable length, and kilovoltage on fluorescent screen brightness.

SUMMARY

It is concluded that dose rate may not be considered to be linear with tube current in equipment of the type studied. The actual relationship between dose rate and tube current depends upon the cable length and kilovoltage; hence the only safe procedure would seem to be to take measurements under actual operating conditions.

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(*Pro le summario in interlingua, vider le pagina sequente*)

SUMMARIO IN INTERLINGUA

Influentia del Longor del Cablo Super le Dosage e le Spissitate de Medie Valor in Manovras de Diagnose a Radios X

Esseva effectuate un studio del effecto exercite per le longor del cablo super le dosage al patiente, con un rectificator de unda complete classate pro un voltage maxime de 130 kvp e un currente maxime de 500 ma. Un rotante tubo anodic a alte voltage de un simile classamento esseva usate. Ab le listas de catalogos regular, quatro gruppos de cablos esseva seligite, con longores del cablos individual de 15, 24, 30, e 40 pedes.

Es concludite que il non es correcte considerar le dosage como linearmente relationate al currente del tubo in un apparatura del typo studiate. Le relation real inter le dosage e le currente del tubo depende del longor del cablos e del kilovoltage, de maniera que le sol methodo secur pare esser le obtention de mesuramentos sub le conditiones del practica mesme.

Etiam le alterationes del spissitate del medie valor effectuate per variationes in le longor del cablos, in le currente del tubo, e in le kilovoltage esseva determinate. Iste alterationes exhibiva le comportamento expectate super le base de considerationes del studios del dosage.

High-Energy Electrons in the Treatment of Malignant Tumors of the Thorax[1]

ERICH M. UHLMANN, M.D., F.A.C.R., and JACQUES OVADIA, Ph.D.

THE TREATMENT of malignant neoplasms within the thoracic cage is a challenge to the surgeon as well as to the radiotherapist. The paucity of beneficial results and the low five-year survival rates are an indication of the futility of most therapeutic efforts. Primary carcinomas of the esophagus and of the bronchus continue to present the highest death rates; although the absolute number of individuals who have been successfully treated has increased, the five-year survival percentage figures have shown little improvement, for reasons which are well known. The insidious onset of these neoplasms seldom permits the establishment of an early diagnosis; the advanced stages of the diseases necessitate major surgery. Such procedures, although feasible and in the hands of experienced surgeons technically successful, often result in clinical failures due to the debility of the patients. Radiotherapy faces serious difficulties because the ionizing radiation necessary for control of these neoplasms requires a large tumor dose which often cannot be tolerated by the afflicted patients.

An illustration of the problems confronting the surgeon and radiologist is offered in a pertinent instance of a carcinoma of the esophagus where 80 per cent of the esophagus was resected and the entire stomach placed in the thoracic cage (Fig. 1). Within ten weeks after surgery complete obstruction of the remaining part of the esophagus developed as a result of spread of the original carcinoma, with subsequent extension of the disease to the lymph nodes of the neck. The operative result must be considered a failure, although the entire visible neoplasm was eradicated. More than likely, the rapid spread was a sequel of surgery itself.

Fig. 1. Carcinoma of the esophagus. Eighty per cent of the esophagus was resected and the stomach was placed in the thoracic cage.

A second example is a carcinoma of the right middle and lower lobes of the right lung. A complete atelectasis developed in the right hemithorax (Fig. 2) following bronchoscopy, and since the patient also suffered from severe asthma and emphysema, surgery was considered to be too great a risk.

The obvious need for improvement of surgical results is the establishment of an earlier diagnosis, but the reality has to be faced that, despite serious efforts, this goal probably will not be achieved for a period of many years, and probably not at all unless a simple test is developed for the recognition of cancer in its incipient stage. At present, therefore, we are forced to seek an improvement in the treatment methods which will be applicable even in advanced

[1] From the Tumor Clinic of Michael Reese Hospital and Medical Center, Chicago, Ill. Presented at the Forty-fifth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 15-20, 1959.

Fig. 2. Complete atelectasis after bronchoscopy in a case of carcinoma of the right middle and lower lobe.

stages of the disease. There still will remain the limitation that involvement must be confined to the thorax itself; in the presence of metastases to other organs, it is unreasonable to expect more than palliation. We believe that our experience with high-energy electrons in the therapy of malignant neoplasms of the thorax is such as to recommend this modality in their treatment.

Reports of the technical developments of the apparatus for electron therapy and its adaptation to clinical application have been published (1–3), and preliminary accounts of our clinical experience in deep-seated tumors were presented before this Society at its 1958 meeting (4) and before the Ninth International Congress of Radiology in 1959 (5). Our observations indicate that large doses of effective ionizing radiation can be applied to deep-seated tumors with a relatively low integral dose to healthy tissue and consequent good tolerance by the patient. The fact that the surrounding tissue receives considerably less radiation than with conventional radiation therapy results in reduced scar formation and better functional results. Examples of therapeutic results in patients with carcinoma of the esophagus and bronchogenic carcinoma who were without exception in an advanced and inoperable stage are presented. Some of these patients already had metastases outside the thorax, although at the time when the treatments were initiated these secondary deposits had not produced symptoms.

Rapid extension of the primary carcinoma or metastatic spread, when it occurred, resulted in such weakening of the patients that interruption of the treatments became necessary. Of a total number of 16 cases of primary carcinoma of the esophagus, this development occurred in 6, and they followed a rapid downhill course. Only 10 of the 16 patients received a minimum of 6,000 r to the esophagus, which at present is considered a satisfactory therapeutic dose. The application of the required amount was technically carried out by utilizing anterior and posterior fields aimed at the esophagus. Roentgenograms with contrast media were taken in the position in which the patient was to be treated in order to localize exactly the area of irradiation. Field sizes up to 20 cm. in length were used and, since these fields were narrow, the total volume dose could be kept small. Two examples of such planning are presented: one for treatment of a relatively small, and the other of a relatively large, tumor mass (Figs. 3A and 3B). The treatment plans show the flexibility of electron beams, which allow for variety in the concentration of the necessary amount of radiation in predetermined areas. The energy used depends on the anteroposterior diameter of the thoracic cage and, as a rule, was in excess of 30 Mev. There was no difficulty in delivering 6,000 to 7,000 r to the esophagus, with a rapid decline of the dose to the periphery of the treatment fields, thereby avoiding irradiation of the lungs. The dose to the spinal column was kept below 4,500 r.

Some of the results in these patients are shown: Figure 4 is of the patient referred to above, in whom resection of 80 per cent of the esophagus was followed by a com-

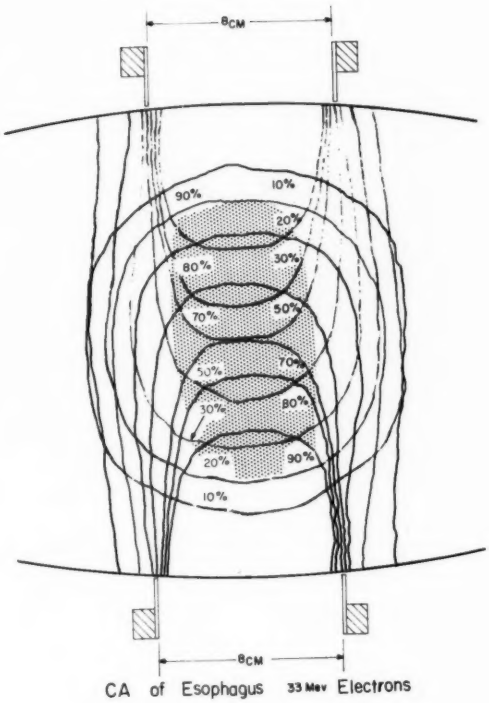


Fig. 3A. Treatment plan for a small carcinoma of the esophagus.

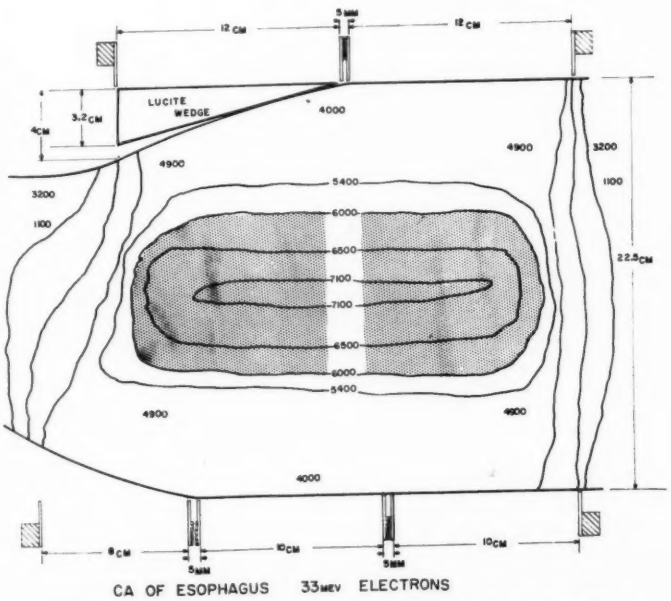


Fig. 3B. Treatment plan for a large carcinoma of the esophagus.

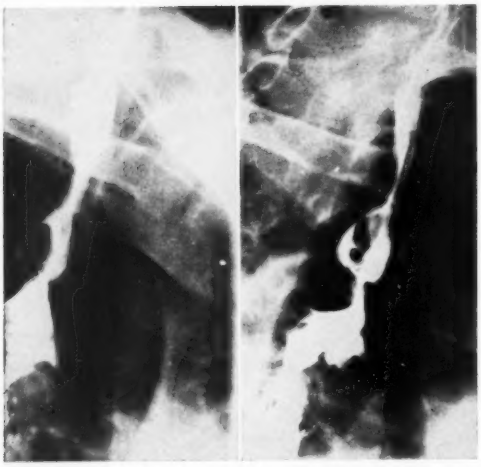
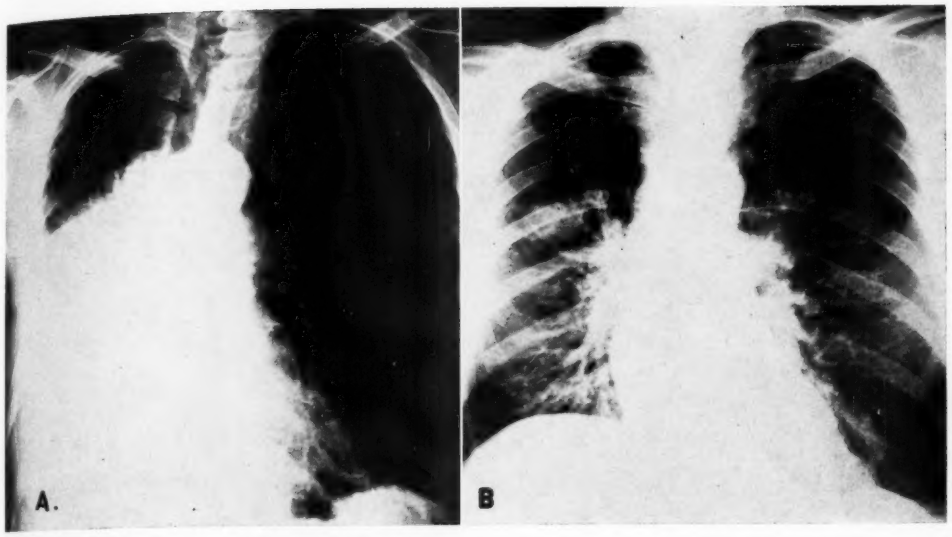


Fig. 4. Patent remnant of esophagus after therapy. Same patient as in Fig. 1.

plete obstruction of the remaining portion, requiring intravenous feedings. Films obtained after electron therapy show a complete opening of the lumen. The patient was able to eat and was comfortable. In other patients, resections proved to be impossible, and only electron therapy was carried out. Partial and complete obstructions of the esophagus were often wholly relieved during treatment. In one patient with almost complete obstruction in the middle and lower portion of the esophagus, subsequent x-ray studies showed disappearance of the entire tumor after therapy; negative biopsies were obtained four months after termination of the treatment, and the patient has survived 19 months without symptoms.

Of the 10 patients who received what we consider to be a full course of radiation therapy to the esophagus, 4 are dead. One of these patients lived without symptoms referable to the esophagus for almost two years and died of congestive heart failure from which she had been suffering for many years. Another lived without symptoms for more than six months and died from an unrelated cause. Of the 2 remaining patients, one already had a gastrostomy performed before radiation treatment; after termination of the therapy she was able to swallow without interference but died from direct extension of the original tumor into the stomach and metastases to the liver. The other had involvement of the stomach at the time of treatment and, although the lumen of the esophagus became patent after therapy, metastases to the lungs and liver caused his death. The survival times of the 6 patients still living are: for 1,

Fig. 5. A. Exit doses before utilization of wedges. B. Same patient after interposition of wedges.



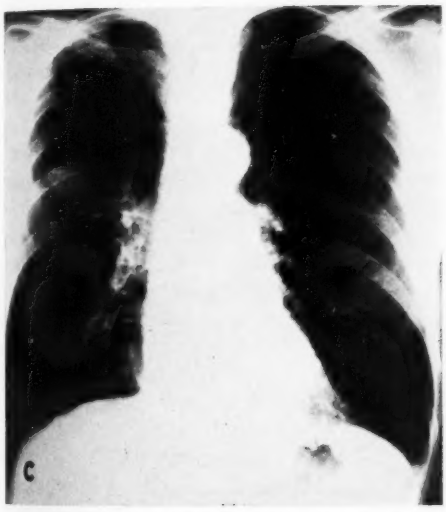


Fig. 6. A. Clearance of atelectasis during treatment. Same patient as in Fig. 2.
B. Status at termination of treatment; outline of original tumor visible.
C. Status three months after termination of therapy.

nineteen months; for 2, more than nine months; and for 3, less than six months.

In none of the treated patients, although most of them were in an advanced stage of the disease, and although large doses of radiation were given, were any serious complications produced; specifically, not a single perforation occurred.

The treatment of carcinoma of the bronchus with high-energy electrons presented specific problems which had to be solved for effective therapy. One of the most important is the wide variety of tissue density within the area to be irradiated. The range of electrons depends mainly on their energy and the density of the tissue traversed. The *effective* range in unit density material at which a useful dose can be obtained can be approximated by dividing the energy by a factor of 3, indicating that electrons with an energy of 30 Mev would be most effective up to a depth of 10 cm.

The difference in absorption of electrons in lung tissue was first noticed when exit doses were observed in the treatment of relatively thin patients. An example of such variations is shown in Figure 5, A, which was obtained with 28-Mev electrons; the shadows of both lungs are clearly apparent. The problem of avoiding such exit doses and still using effective therapy cannot be solved by the device of lowering the energy because parts of the area to be irradiated would then be undertreated. We therefore utilize Lucite wedges, individually shaped for the specific patient and the specific lesion, according to findings in film exposures. In Figure 5,B, a film ob-

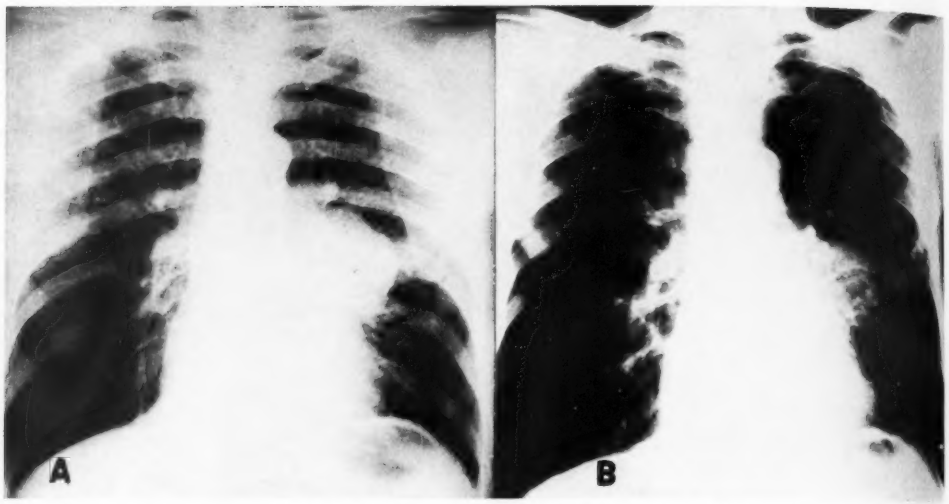


Fig. 7. A. Adenocarcinoma of the lung before treatment. B. Same patient after termination of treatment.

tained with interposed wedges is shown, indicating the possibility of avoiding unnecessary exposure to healthy tissue and at the same time delivering an effective therapeutic dose.

The total number of patients treated for carcinoma of the bronchus is 22. In 4 instances, treatments were interrupted because of the debility of the patient and/or the appearance of widespread metastases. In a fifth patient, with involvement of the left lung, metastases to the right lung and skeletal system appeared before termination of the local treatment, and, although the response in the treated area was excellent, the patient died from metastatic spread.

Of the remaining 17 patients, 4 are dead. Two of these died of unrelated causes, but showed complete regression of the original tumors (Figs. 6 and 7). Two others died from metastases after disappearance of the local lesions. Of the 13 surviving, 2 have remained free of symptoms for one year, 5 for more than six months, and 6 less than six months. Examples of results in the surviving patients are shown in Figures 8 and 9.

The investigations presented here are considered a step in adapting a new modality of ionizing radiation for effective therapy in cancer of the esophagus and bronchus. The preliminary therapeutic results must be interpreted with the knowledge that none of these patients was operable and that most of them were of advanced age and debilitated by their disease. The outlook with other forms of radiation therapy was poor, and it was often questionable whether the patient could tolerate exposure to the necessary high doses of conventional x-rays. As a general rule, therapy was started while the patient was hospitalized. The majority could be treated on an ambulant basis, because the by-effects of electron therapy are mild and the general condition of the patient so little influenced that hospitalization is usually unnecessary. It should also be emphasized that the local response to therapy in those who did not survive was remarkable in all instances, and was confirmed in later autopsy findings.

We believe that objective evaluation demonstrates the effectiveness of therapy with high-energy electrons in these advanced cancers. From experiences with electron therapy of tumors in other areas which were less advanced and offered a better prognosis, we believe that the utilization of high-energy electrons in the treatment of earlier diagnosed carcinomas of

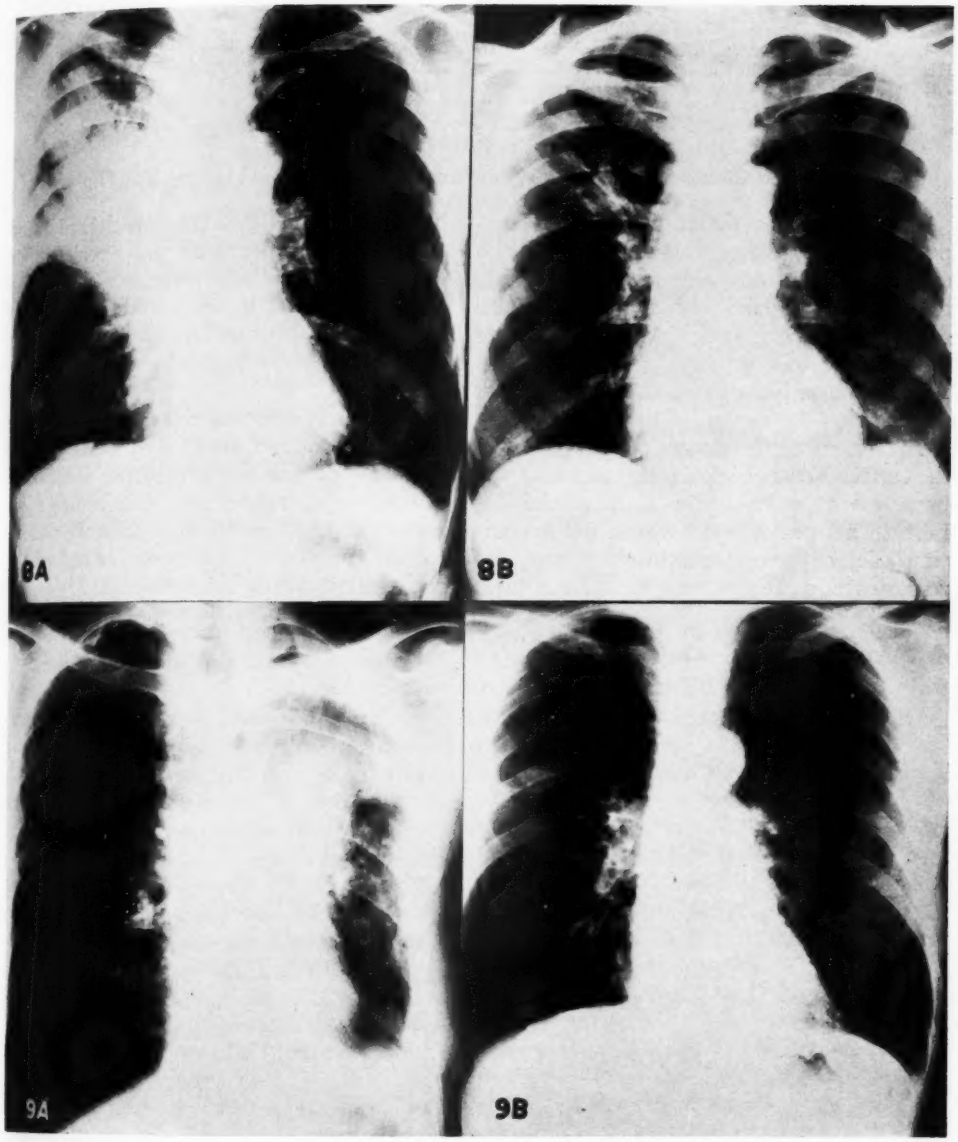


Fig. 8. A. Squamous-cell carcinoma of the lung before therapy. B. Same patient at termination of therapy.
Fig. 9. A. Oat-cell type of carcinoma of the lung before treatment. B. Same patient after therapy.

the esophagus and the bronchus is justified and should result in a considerably higher five-year survival rate than can be achieved at present with conventional methods of radiation therapy and surgery.

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SUMMARIO IN INTERLINGUA

Electrones de Grande Energia in le Tractamento de Tumores Maligne del Thorace

Dece-sex casos de carcinoma del esophago e 22 casos de carcimona del broncho esseva tractate con electrones de grande energia. Per medio de iste agente un alte dosage de efficace radiation ionisante pote esser applicate a tumores profunde con un relativemente basse dose integral in histos normal.

In 6 del casos de cancere esophagee e in 5 de cancere bronchial, le tractamento debeva esser interrumpite a causa del debilitate del patiente o a causa del apparition de extense metastases. Octo del remanente patientes moriva. Le alteres habeva supervivite al tempore del redaction del presente reporto durante periodos de inter minus que sex menses e quasi duo annos. Mesmo in le patientes qui non superviveva, le responsa local al therapia, confirmate al necropsia, esseva remarcabile.

Nulle del patientes esseva operabile, e le majoritate esseva debile e de etate avantiate. Le prospectos pro altere formas de radiotherapia esseva mal, e in multe casos il esseva questionabile si le patiente poteva tolerar le forte exposition necessari in roentgenotherapia conventional.

Exit Dosimeter for Effective Patient Thickness[1]

R. G. WOODLEY, M.S., E. L. BRONSTEIN, M.D., and J. S. LAUGHLIN, Ph.D.

AN ADEQUATE radiation treatment plan should give the actual dose distribution at all pertinent points within the patient. Most plans are based on the assumption that the irradiated tissues are of homogeneous unit density. In certain regions, however, there are major deviations from homogeneity and here treatment plans should be corrected for the presence of varying tissue components.

The effect of these inhomogeneities may be estimated by making an assumption as to the distribution of bone, muscle, and fat in the region to be treated and calculating the dose configuration with the aid of absorption and scattering coefficients and the isodose distribution in water (1). In practice, however, it is difficult to determine the thickness of each tissue traversed, so that this method is seldom applicable.

One method of gross correction for the variation in tissue distribution of patients treated by rotation, or by telecobalt units, has been the use of a transit meter, which measures the primary beam attenuation and relates it to the amount of absorbing material present (2–6). Depth dose curves may then be modified accordingly. Transit meters require a large amount of heavy shielding for collimation, or location at a considerable distance beyond the patient to minimize scattered radiation effects. Versatility is, therefore, limited in most cases to a permanent installation, and measurements are restricted to a single axis, usually the central axis.

Another method for making corrections is provided by an exit dosimeter (7). With this instrument, the exit dose on the body of the patient is measured relative to the maximum dose, and the treatment plan is then modified according to these values. The exit dosimeter described here is light and versatile and may be used at any position on the patient, for any direction of field. It is designed to measure the actual exit dose at any specified point, permitting appropriate modification of the planned isodose distribution. This instrument has been calibrated and tested for 250-kv x-rays and for 2-Mev Van de Graaff x-rays. Its use with 2-Mev Van de Graaff x-rays is reported here.

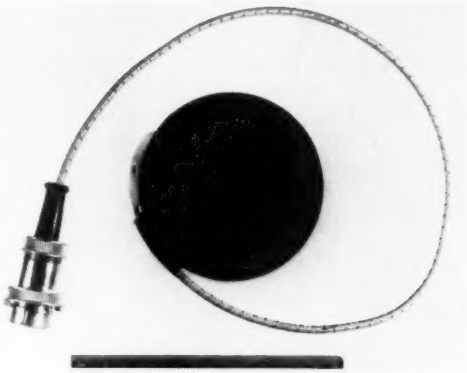

Fig. 1. Top view of exit dosimeter with cable and connector. The dosimeter is 4 mm. thick.

Exit Dosimeter Details: The exit dosimeter, as illustrated in Figures 1 and 2, is a parallel-plate ionization chamber with dag-coated polystyrene walls. The upper wall is 1.5 mm. thick and the lower wall 3 mm. thick, with a 1.5 mm. spacing between plates. Guard rings surround both the high-voltage and collector electrodes and are connected to ground, as are the outer exposed surfaces of the dosimeter. The diameter of the collecting electrode is 3 cm., which results in a collecting volume of 1.12 c.c. The chamber electrodes are connected through a 2-foot cable to a preamplifier with an input resistance of 4×10^{10} ohms, and this is connected through a 50-foot cable to a

[1] From the Departments of Physics and Radiation Therapy, Memorial Center for Cancer and Allied Diseases, New York, N. Y. Presented at the Forty-fifth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 15–20, 1959.

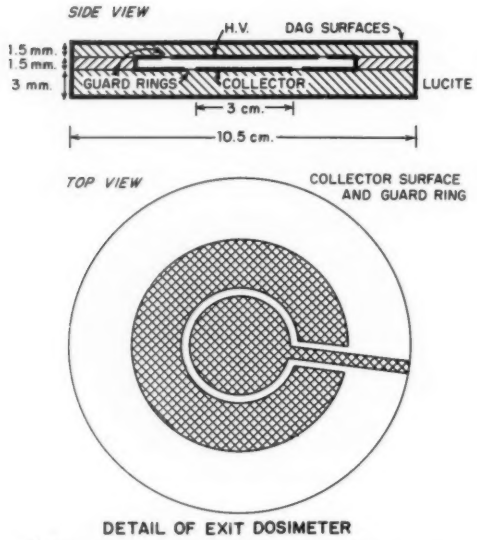

Fig. 2. Construction details of the exit dosimeter.

Radocon amplifier, where the dose rate is read directly. The time constants are such that a reading may be made in twenty seconds. The potential on the high-voltage electrode is maintained at 25 volts.

Exit Dosimeter Calibration: Calibration, as illustrated in Figure 3, was made with x-rays from a 2-Mev Van de Graaff generator at h.v.l. of 6.3 mm. Pb, with the chamber located 120 cm. from the tube target. A box with Lucite walls and cross-sectional dimensions of 25 × 25 cm. was placed above the chamber, and the water level in it was varied from 0 to 28 cm. Response of the chamber, with various water depths (in centimeters) relative to that with zero water depth, is plotted in Figure 4, for field sizes ranging from 5 × 5 cm. to 20 × 20 cm. Included in the figure are relative measurements from a transit meter with collimator which are equivalent to exit dosimeter measurements for a 0 × 0-cm. field size. As measurements are taken during actual treatment, the TSD is kept constant at 100 cm. so that the target-chamber distance may vary from 115 to 125 cm. The use of a 120-cm. target-chamber distance for calibration of the dosimeter was found to introduce no detectable error.

Exit Dose Measurements on Patients: A measurement was made at the center of the exit field for patients undergoing radiation therapy (a special backpointer was useful for accurate positioning). At the conclusion of the treatment, an additional measurement was made without the patient but under the same conditions and

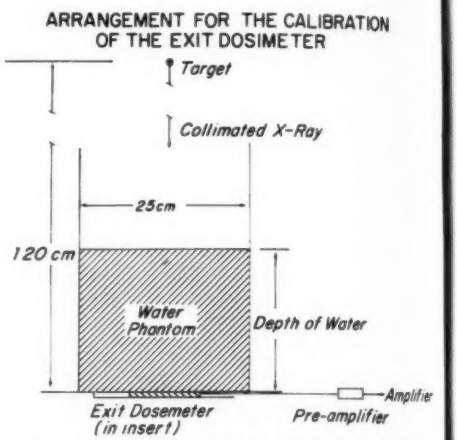

Fig. 3. Calibration details of the exit dosimeter. Field size varied from 5 × 5 cm. to 20 × 20 cm. Water depth varied from 0 to 28 cm.

at the previous target-chamber distance. By interpolating the field size on the calibration curves, the ratio of these measurements was employed to obtain an equivalent water thickness. This thickness of water has the same exit dose as that observed for the patient. For highly elongated or irregular fields, where interpolation on the calibration curves is difficult, a measurement may be made on the patient, following treatment, at a standard field size, *e.g.*, 5 × 5 cm. The equivalent thickness may then be obtained from the calibration curves for this field size. In the same way, the lateral variation of inhomogeneity may be determined by measuring the equivalent water thickness of the patient at several points across the field.

The doses at points within the irradiated

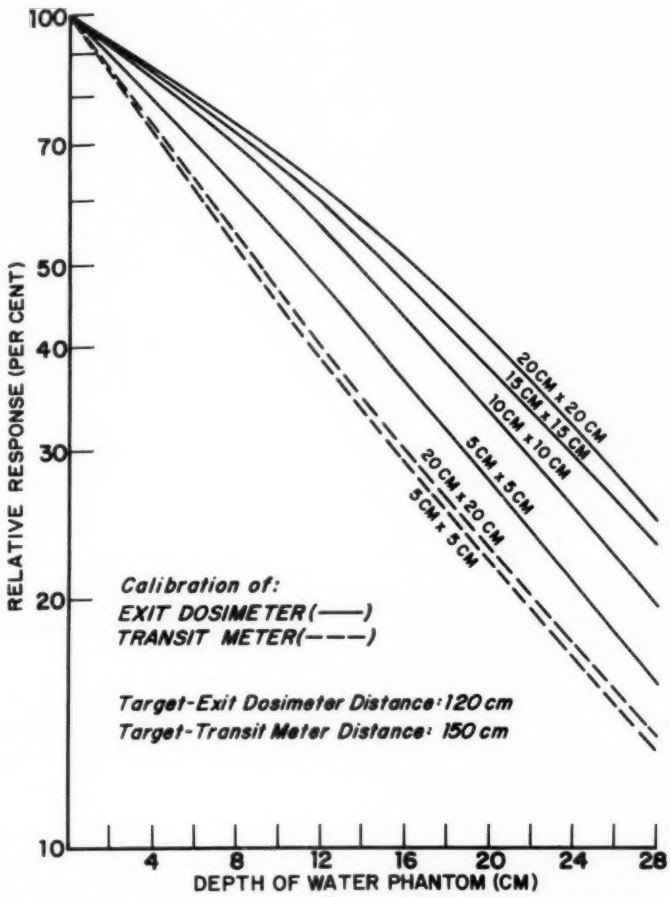

Fig. 4. Results of calibration of the exit dosimeter and transit dosimeter.

tissue volume were corrected proportionally, unless knowledge of anatomical inhomogeneities permitted discontinuous modification of the internal portion of the treatment plan.

RESULTS

Table I gives the equivalent water thicknesses of several patients as measured with the exit dosimeter. Measurements were taken with a field size of 5 × 5 cm. (anterior and posterior portals) in the pelvic, abdominal, and thoracic regions. These are compared with the physical dimensions as measured by calipers and with an equivalent thickness as measured by a transit meter. The exit dosimeter agrees with the transit meter on all fields. The fields with equivalent thicknesses that deviated significantly from the patient's dimensions were primarily those in the region of air-containing lung.

An example of a corrected treatment plan is compared with the original in Figure 5, where the equivalent thicknesses at 3-cm. intervals across the exit field were 14.7 cm., 13.6 cm., and 11.0 cm., while the patient's diameters measured by calipers were 20.8 cm., 19.6 cm., and 18.0 cm., respectively. The mid-plane tissue dose in the corrected case is 70 per cent of the maximum, whereas the original estimate of a

TABLE I: COMPARISON OF EQUIVALENT PATIENT THICKNESSES

Summary of measurements of equivalent patient thicknesses as measured by the exit dosimeter (T_1), transit meter (T_2), and by calipers (T_3). The per cent differences between exit dosimeter measurements and the caliper measurements are given in columns 7 and 12. The per cent differences between transit dosimeter measurements and caliper measurements are given in columns 6 and 11.

Patient	Region	Anterior Field					Posterior Field				
		T_1 cm.	T_2 cm.	T_3 cm.	% Diff. $\frac{(T_2-T_3)}{T_3} \times 100$	% Diff. $\frac{(T_1-T_3)}{T_3} \times 100$	T_1 cm.	T_2 cm.	T_3 cm.	% Diff. $\frac{(T_2-T_3)}{T_3} \times 100$	% Diff. $\frac{(T_1-T_3)}{T_3} \times 100$
1	Thorax, lung	19.9	20.9	20.2	+ 3.5	− 1.5	19.8	19.9	23.2	−14.2	−14.7
2	Thorax, lung	16.8	15.5	19.8	−21.7	−15.2	13.3	11.8	19.9	−40.7	−33.2
3	Thorax, lung	13.2	15.1	20.7	−27.0	−36.2	12.9	10.6	20.2	−47.5	−36.2
4	Thorax, lung	12.8	...	17.4	...	−26.4	14.7	...	18.8	...	−21.8
5	Thorax, lung	12.4	13.3	19.7	−32.5	−37.0	11.7	11.4	20.6	−44.6	−43.2
6	Thorax, lung	13.0	12.0	15.6	−23.1	−16.7	9.3	9.7	13.2	−26.5	−29.5
7	Thorax, lung	17.4	17.3	18.8	−8.0	−7.4	14.2	14.7	16.8	−12.5	−15.5
8	Thorax, lung	20.8	...	24.3	...	−14.4	22.6	...	25.5	...	−11.4
9	Thorax, med.	...	21.2	21.2	0.0	...	21.4	20.5	20.6	−0.5	+3.9
10	Thorax, med.	19.3	20.0	19.6	+2.0	−1.5	21.6	20.1	20.6	−2.3	+4.9
11	Thorax, med.	19.8	20.6	20.2	+2.0	−2.0	19.4	20.2	20.8	−2.9	−6.7
12	Thorax, med.	16.1	16.0	15.7	+1.9	+2.5	...	...	...	...	...
13	Thorax, med.	22.7	...	23.4	...	−3.0	...	...	...	...	...
14	Pelvis	18.0	18.2	17.8	+2.2	+1.1	18.7	19.6	18.6	+5.4	+0.5
15	Pelvis	20.4	...	19.1	...	+6.8	19.7	19.3	19.3	0.0	+2.1
16	Pelvis	24.1	24.5	24.2	+1.2	−0.4	22.6	23.2	24.0	−2.3	−5.8
17	Pelvis	24.7	25.7	24.0	+7.1	+2.9	24.0	24.6	23.6	+4.2	+1.7
18	Pelvis	16.6	17.1	16.7	+2.4	−0.6	16.9	17.6	17.4	+1.1	−2.9
19	Abdomen	20.6	20.2	20.1	+0.5	+2.0	18.4	18.3	18.1	+1.1	+1.6
20	Abdomen	21.4	21.8	22.0	−0.9	−2.7	19.3	19.3	19.6	−1.5	−1.5
21	Abdomen	20.1	20.7	20.4	+1.5	−1.5	16.9	18.8	17.8	+5.6	−5.0
22	Abdomen	22.7	22.2	24.6	−9.8	−7.7	...	20.1	19.8	+1.6	...
23	Abdomen	19.5	19.9	20.0	−0.5	−2.5	18.4	18.4	17.9	+2.8	+2.8
24	Abdomen	21.1	21.1	22.2	−5.0	−5.0	17.9	19.0	19.0	0.0	−5.8

T_1: Effective thickness of patient as measured by the exit dose meter.
T_2: Effective thickness of patient as measured by the transit meter.
T_3: Thickness of patient as measured by calipers.

mid-plane tissue dose was only 57 per cent of maximum. In this case, a conventional treatment plan would have underestimated the actual tissue dose by about 25 per cent.

The effect of the position of an air cavity within the water phantom has been determined by varying the depth of a hollow chamber with thin Lucite walls, 4 cm. deep, and 20 × 20 cm. in cross section. Measurements were made with this chamber in a water phantom 20 cm. deep (Fig. 3) with field sizes of 5 × 5 cm. and 20 × 20 cm. The results (Fig. 6) show that the equivalent thickness factor is affected significantly (by more than a few per cent), in only those instances in which the field size is large or when the cavity is near the exit surface.

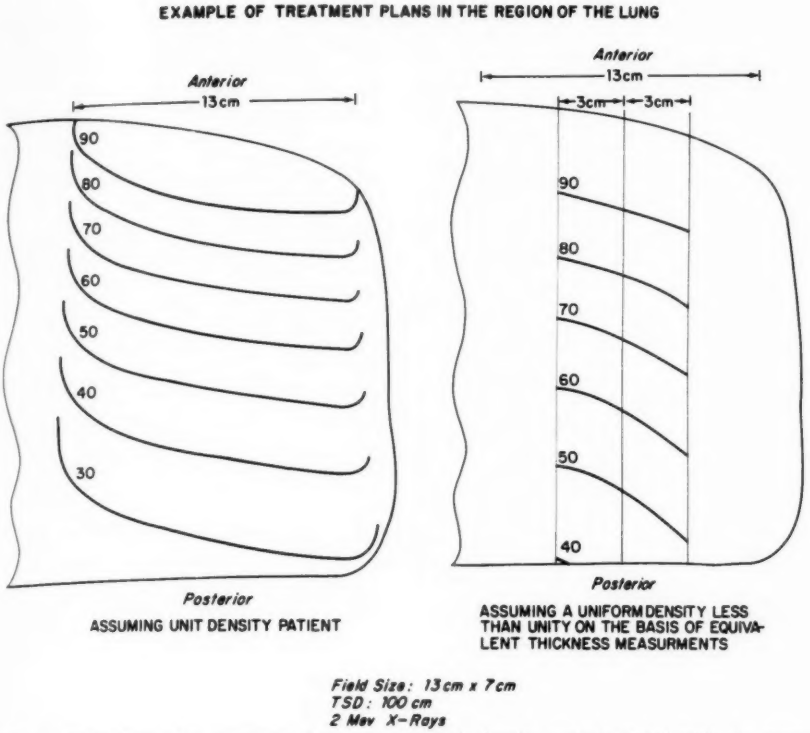

Fig. 5. Comparison of a treatment plan assuming unit density material (left) with the same plan modified on the basis of exit dose measurements (right).

Although the diameter of air-containing tissues in the irradiated region of a patient may sometimes be greater than 4 cm., the location will seldom be such as to affect the equivalent thickness, as measured by this method.

SUMMARY

The design, construction, and calibration of an instrument, "the exit dosimeter," have been presented. This instrument makes possible the convenient determination of the equivalent water thickness of a patient for any axis along a radiation field by a simple exit field measurement. Results obtained with fields in the pelvic, abdominal, and thoracic regions are reported for 25 patients. Agreement with measurements made under similar conditions with a collimated transit meter demonstrates the accuracy and versatility of this instrument. Modification of treatment plans based on the experimental determination of exit dose has been illustrated for one case.

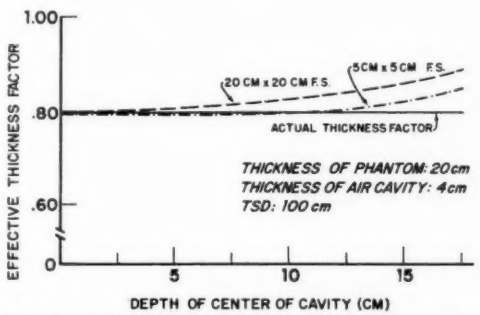

Fig. 6. Effect of the position of a cavity on the effective thickness of a phantom.

NOTE: The authors wish to express their appreciation to Mr. Edward Holodny for his assistance with the measurements.

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SUMMARIO IN INTERLINGUA

Le Dosimetro de Exito pro le Effective Spissitate del Patiente

Es presentate le planos, le construction, e le calibration de un instrumento, le "dosimetro de exito," que rende possibile le determination del equivalente spissitate de aque pro un patiente in non importa qual axe al longo de un campo de radiation per un simple mesuration del campo de exito. Es reportate le resultatos obtenite pro 25 patientes con campos in le regiones pelvic, abdominal, e thoracic. Un bon accordo con le mesurationes effectuate sub simile conditiones per medio de un collimate transitometro indica le accuratia e le versatilitate del instrumento.

Le modification del plano de therapia super le base del determination experimental del dosage de exito es illustrate pro un caso.

Subcutaneous Ossification of the Legs in Chronic Venous Insufficiency[1]

HEINZ I. LIPPMANN, M.D., and RALPH R. GOLDIN, M.D.

THE PRESENCE OF subcutaneous ossification in the legs associated with chronic venous insufficiency has recently been described by one of us in a preliminary report (1). The present paper is concerned with the correlation of radiologic and clinicopathologic features and with some refinements in the roentgenographic demonstration of this condition.

Chronic venous insufficiency is defined as tissue damage due to abnormalities in venous blood flow (2, *a*). In the lower extremities, these abnormalities are frequently caused by varicosities of the greater saphenous system or by pathologic conditions in the deep veins (obstruction or insufficiency). Less frequently, varicosities in the lesser saphenous system are contributory. Other less common causes are acquired arteriovenous fistulas and vascular malformations. Dependent edema is an important mechanism in the development of chronic venous insufficiency.

Clinical manifestations of chronic venous insufficiency are chronic dermatitis and cellulitis, and atrophy of skin and subcutaneous tissue with induration and brown discoloration. Later sequelae include recurrent ulceration and subcutaneous ossification.

MATERIAL AND METHODS

Sixty patients with subcutaneous ossification of the leg were studied. These include 23 described in the preliminary report. Of the latter group, all were re-evaluated roentgenographically and some were re-examined with special technics. The condition was unilateral in 33 and bilateral in 27 patients. This report, therefore, is based upon the study of 87 legs in 60 patients. In six cases there was pathologic confirmation of subcutaneous ossification from biopsy specimens which were obtained during surgical treatment for complication of chronic venous insufficiency. In all legs, the clinical and roentgenographic findings appeared sufficiently distinctive to warrant a diagnosis of subcutaneous ossification.

TABLE I: CLINICAL DATA FOR 60 CASES OF SUBCUTANEOUS OSSIFICATION OF THE LEGS

Total number of patients	60
Unilateral	33 (55%)
Bilateral	27 (45%)
Sex: Female	60 (100%)
Age: 46 to 78 years (av., 60.2 years)	
Chronic venous insufficiency	60 (100%)
Varicose veins	54 (90%)
Alone	19 (32%)
Combined with disease of deep veins	35 (58%)
Deep vein involvement without varicosities	6 (10%)
Recurrent ulcerations (history or physical examination)	54 (90%)
Obesity	57 (95%)
Associated diseases	13 (22%)
Arteriosclerosis obliterans, 8: diabetes mellitus, 6; hypertension, 6; severe chronic arthritis of lower extremities (osteo- or rheumatoid), 6	
Epidermophytosis of feet	60 (100%)

Of the 60 patients, 9 were observed at the peripheral vascular clinic and the wards of the Bronx Municipal Hospital Center, 29 at the peripheral vascular clinic of the Sidney Hillman Health Center, and 22 in private practice.

The national and racial origin of these patients corresponded to that of the general population in these three groups. All 60 patients were females and past the menopause. Their average age was 60.2 years at the time of the first examination (forty-six to seventy-eight years). The incidence of associated diseases and other clinical data are summarized in Table I. The diagnosis of chronic venous insufficiency was established by conventional methods (1).

Blood concentrations of calcium, phos-

[1] From the Departments of Rehabilitation Medicine (H. I. L.) and Radiology, The Albert Einstein College of Medicine, Yeshiva University and Bronx Hospital Center, New York, N. Y. Accepted for publication in April 1959.

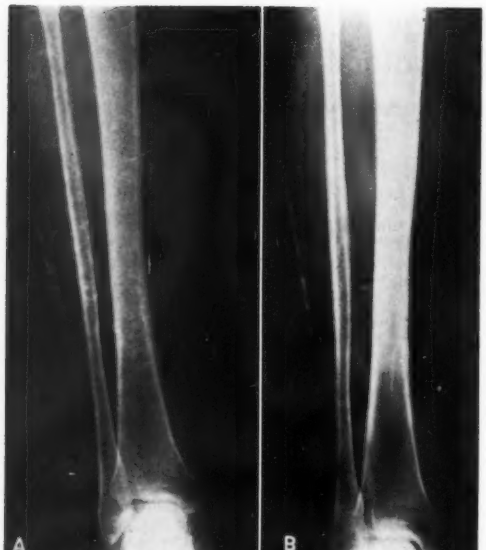

Fig. 1. A. Left leg showing soft tissue ossification. B. Laminagram of same leg showing subcutaneous distribution of ossification.

phorus, alkaline phosphatase, and total proteins were determined in 50 patients and were found to be within normal range in each instance. Sulkowitch reagent tests were performed in random urine specimens in the first 23 patients. They were omitted in all subsequent cases, since the results could not be correlated with the clinical findings.

ROENTGENOGRAPHIC TECHNICS

Laminagraphic studies were made in 13 cases, in the anteroposterior and lateral projections.

Venography was performed by injecting 5 to 15 ml. of contrast medium (usually 35 per cent Diodrast) into a superficial varicosity proximal to the site of ossification, with the leg in a dependent position at 30 to 40°. Films were made immediately and followed up to two minutes. This procedure was carried out in 33 cases.

Soft-tissue technics were of great value in demonstrating the lesions. Routine films obtained with bone technic frequently failed to reveal the small subcutaneous ossifications.

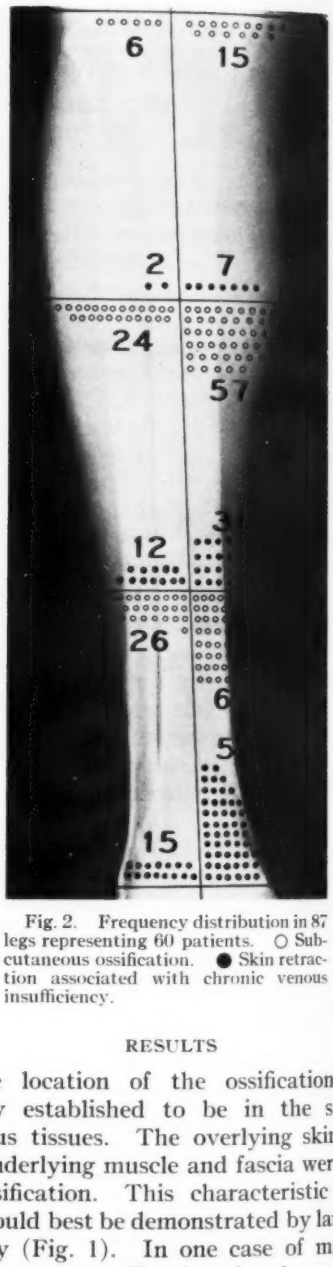

Fig. 2. Frequency distribution in 87 legs representing 60 patients. ○ Subcutaneous ossification. ● Skin retraction associated with chronic venous insufficiency.

RESULTS

The location of the ossification was clearly established to be in the subcutaneous tissues. The overlying skin and the underlying muscle and fascia were free of ossification. This characteristic location could best be demonstrated by laminagraphy (Fig. 1). In one case of marked subcutaneous ossification, involvement of the subcutaneous tissues of the lower thigh was present.

No soft-tissue ossification of the feet was found. In 5 cases in which roentgenographic surveys of the entire body were

TABLE II: ASSOCIATED ROENTGENOGRAPHIC FINDINGS IN 87 LEGS WITH SUBCUTANEOUS OSSIFICATION IN 60 PATIENTS

Skin retraction with reduction in thickness of subcutaneous layer (chronic venous insufficiency)	70 (80%)
Periosteal new bone formation	52 (60%)
Fibula	30 (35%)
Tibia and fibula	21 (24%)
Tibia	1 (1%)
Other soft-tissue calcifications	
Arterial	10 (12%)
Phleboliths	26 (29%)
Undetermined	20 (24%)

made, no other sites of subcutaneous ossification were discovered. In several additional cases, random roentgen examination of upper and lower extremities failed to disclose subcutaneous ossification elsewhere than in the legs.

Many of the pathologic signs of chronic venous insufficiency were demonstrated radiographically and showed a distribution strikingly similar to that of the subcutaneous ossification. Thus, atrophy of the skin and subcutaneous tissue frequently produced a localized soft-tissue depression, most commonly along the medial aspect of the lower third of the leg, corresponding in location to the most frequent site of ossification (Fig. 2).

Venography demonstrated that the ossifications were not a part of the opacified veins. In some cases, the bone plates were seen to lie between veins or adjacent to a vein (Fig. 3).

The roentgenographic appearance of subcutaneous ossification was variable. When the ossifications were slight, their recognition was difficult. In these cases, the ossification appeared as specks of increased density which under magnification frequently showed a fine rim with a more lucent center. The densities were variable in shape but most frequently were round or oval, sometimes cylindrical. Often there was interlacing, with formation of a honeycomb pattern. Occasionally, the central lucent zone presented a delicate web-like appearance. The ossifications appeared denser when seen tangentially than *en face*. In more marked cases, the surrounding rims were more prominent and there was further interlacing and

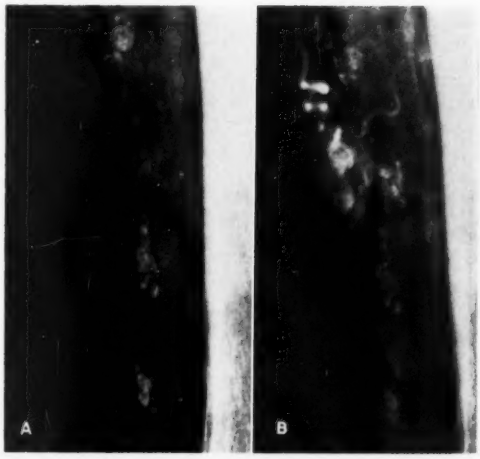

Fig. 3. A. Lower medial aspect of right leg showing subcutaneous ossification.
B. Venogram demonstrating that the ossifications lie outside the veins.

coalescence, with the formation of cords and sheets. In the most marked cases, there was an impression of trabeculation. Occasionally, the sheets of bone encased a portion of the leg completely.

Periosteal new bone formation was encountered in 52 legs, not always confined to the sites of subcutaneous ossification. The fibula was involved in 51 cases, and the tibia in 22. In only a single instance was the tibia involved alone (Table II). There was no correlation between the bone changes and the amount or distribution of subcutaneous ossification.

Seven patients with recognizable arterial calcification were encountered. There were 20 cases of associated soft-tissue calcifications, most of which probably were phleboliths; some of these, however, could not definitely be classified.

CASE REPORTS

CASE I (Fig. 4, A-E): F. S., age 65, female, was first examined in 1950. She had a large ulcer of the lower lateral aspect of the right leg which had been present for twelve years. In addition there was a twenty-year history of varicose veins, with recurrent bilateral ulcerations. Chronic venous insufficiency was present bilaterally, with stony hard subcutaneous induration surrounding both legs from ankle to knee. In December 1951, wide excision of the ulcerated area, including skin and subcutaneous

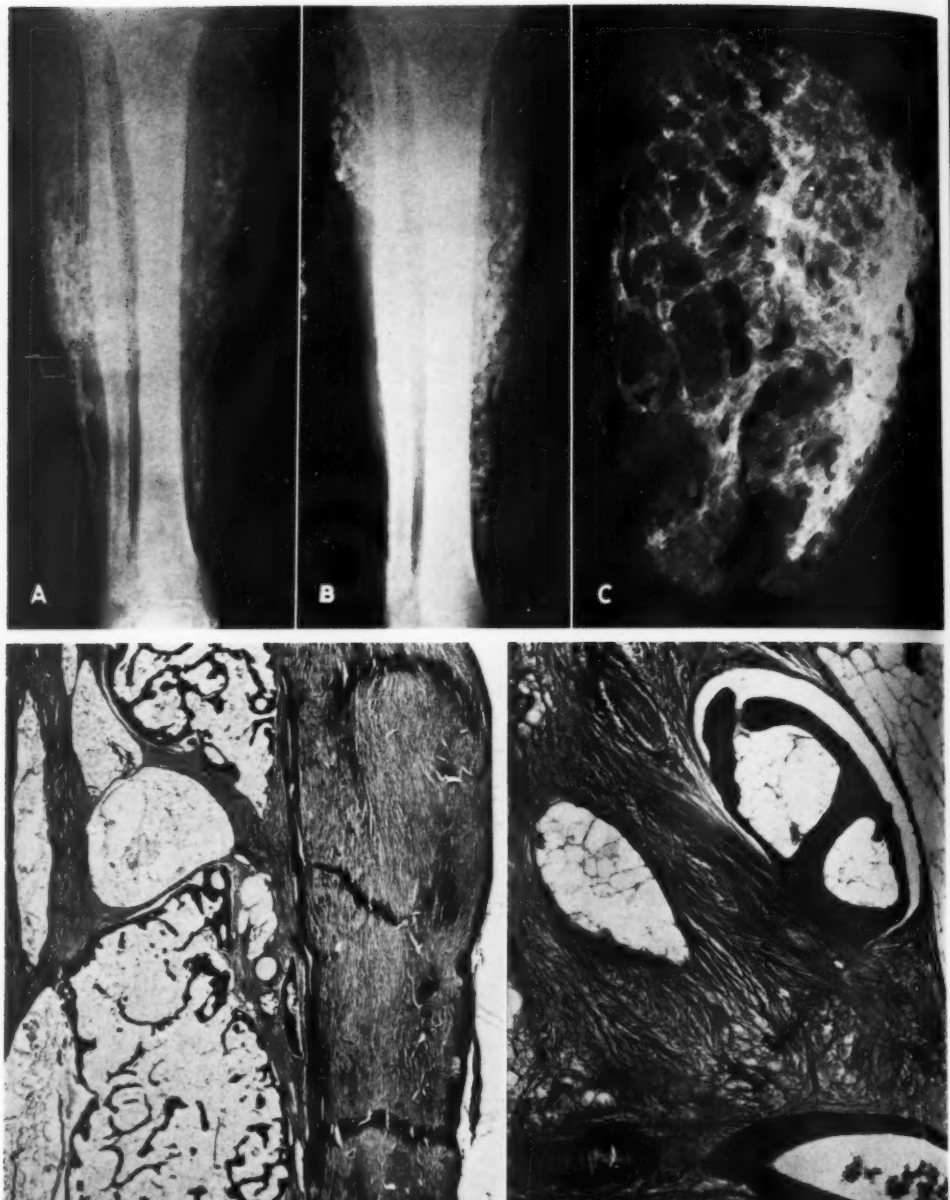

Fig. 4. Case I. A. Right leg, showing extensive subcutaneous ossification.
B. Right leg, seven years postoperative, showing no evidence of subcutaneous ossification in grafted area.
C. Roentgenogram of complete surgically removed specimen measuring 6.25 × 4.5 inches, showing trabecular interlacing bone.
D. Histologic section of entire thickness of removed specimen: skin, scar, and subcutaneous bone. (×5)
E. Histologic section showing subcutaneous bone nodule apart from vein. (×25)

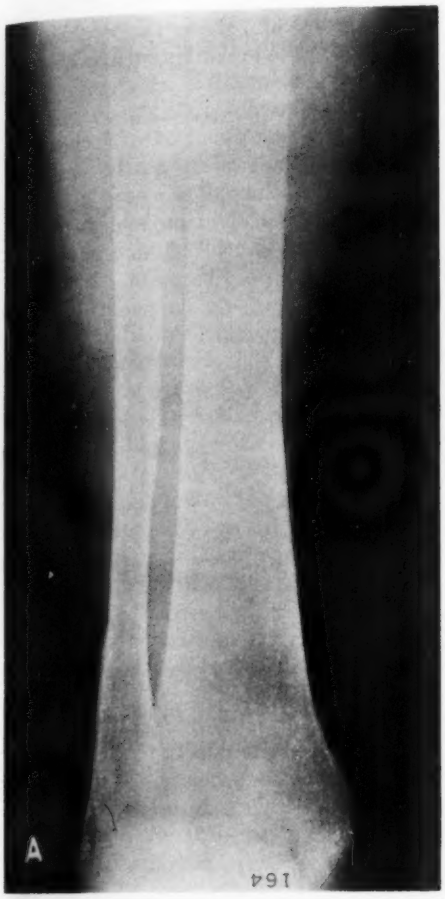

Fig. 5 A. Case II. Laminagram of the right leg showing small faint densities in subcutaneous tissue.

tissue, was performed, with skin grafting over the muscle fascia. This has remained healed to date.

CASE II (Fig. 5, A and B): R. C., age 54, female, was first examined in 1954, when she gave a fifteen-year history of bilateral varicose veins with recurrent cellulitis in the right leg. Several small zones of granular induration were palpated in the subcutis of the medial aspect of the lower third of the right leg. Multiple ligations of the right greater saphenous system were done and some indurated subcutaneous tissue was removed in May 1955.

CASE III (Fig. 6): L. S., age 67, female, was first examined in 1953. She had had bilateral varicose veins, deep phlebitis, cellulitis, and multiple recurrent ulceration for twenty years, and was known to have had diabetes for seven years. Intermittent claudication had been present in both legs for five years. The patient was obese and had advanced bilateral arteriosclerosis obliterans. She died in May 1957 after a myocardial infarction.

CASE IV (Fig. 7, A and B): E. F., age 52, female, when first examined in July 1955, gave a twenty-five-year history of bilateral varicose veins and left

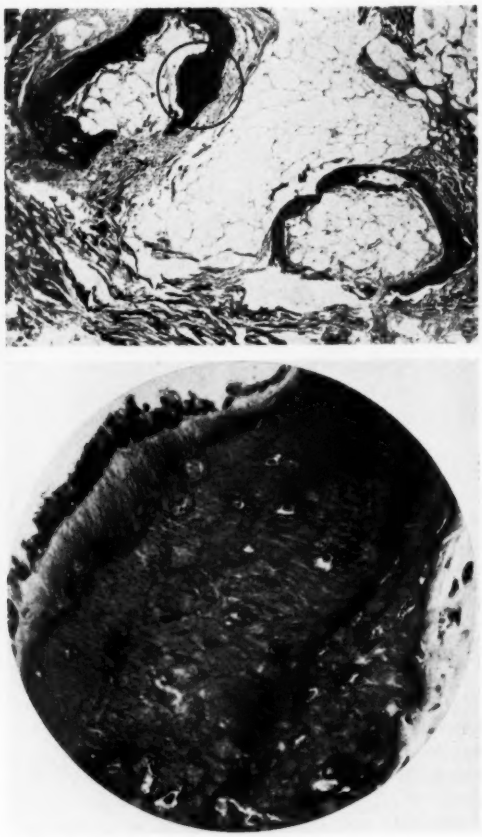

Fig. 5 B. Case II. The upper view is a histologic section showing two subcutaneous nodules of bone. (×15) The lower view is an enlargement of the area encircled above. (×135) Note the layer of osteoblasts and adjacent osteoid tissue.

iliofemoral thrombophlebitis. For nine years, a recurrent left leg ulcer and cellulitis had been present. Subcutaneous plaques were palpated in the left leg from ankle to knee. In December 1955, a wide excision of the ulcerated area containing subcutaneous bone was performed and a skin graft was done. In June 1957, recurrent ulcerations proximal to the graft appeared. This area was excised and a split thickness skin graft was performed in November 1958.

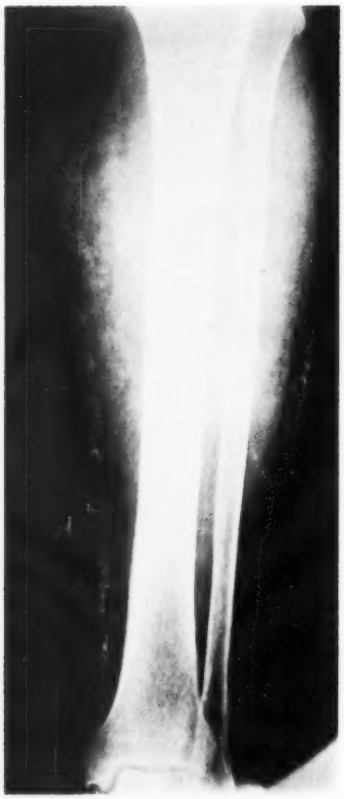

Fig. 6. Case III. Right leg showing subcutaneous ossification.

CASE V (Fig. 8, A and B): R. S., age 57, female, first examined in September 1954, gave a twenty-year history of varicosities in the left leg. She had experienced cellulitis and recurrent ulcerations along the medial aspect of the leg for three years. In July 1955, multiple ligations of the left greater saphenous vein were done and an indurated subcutaneous area measuring 7 × 2 cm. was removed.

DISCUSSION

Subcutaneous osseous deposits in the legs have previously been reported, but their correlation with chronic venous insufficiency has not been noted (3–7). In our series, chronic venous insufficiency was present in every case, the site correlating closely with the location of the subcutaneous ossification (Fig. 2). Arteriosclerosis obliterans, diabetes mellitus, and hypertension were present in too small a number of cases to be considered etiologically significant (Table I). Syphilis, suspected to be etiologic in one reported case (8), was not found in this group, either clinically or serologically.

Subcutaneous ossification of the legs is a common condition. In the past eight years, more than 600 cases of chronic venous insufficiency came under our observation with an overall 10 per cent incidence of subcutaneous ossification. In the past two years, this incidence has increased to about 25 per cent, probably because of a greater index of suspicion. Since only those patients with suggestive palpatory findings have been subjected to roentgenographic examination of the legs, it may be that the true incidence of subcutaneous ossification in our series, especially in its less extensive forms, is even higher.

Subcutaneous ossification of the legs has received only sporadic descriptive attention in the medical literature. Instances of calcified saphenous vein thrombi and calcification in soft tissues in the legs have been reported (14, 2, *b*). Traditionally, calcific densities in the soft tissues of the legs have been thought to represent calcium salt deposits in varicosities or tissue calcification (15, 16), an interpretation we too had erroneously adhered to prior to our first case with pathologic confirmation of subcutaneous ossification.

In our group of 600 cases of chronic venous insufficiency the sex ratio, female to male, approximated 2:1. The ratio for similar groups is generally reported to be 4:1. This discrepancy is accounted for by the rather large number of male workers in the clothing industry who form a preponderant part of one of our groups. It is therefore even more significant that the complication of subcutaneous ossification has been found only in females in this series.

All the patients in our series were beyond the menopause, although many premenopausal females with chronic venous insufficiency came under our observation. The relationship of this condition to sex, age, and menstrual status is being investigated (9).

While chronic venous insufficiency was present in all cases of subcutaneous ossification in this group, the duration of neither condition could be assessed by methods available to us. In those patients in whom subcutaneous bone was removed surgically, no new bone formation occurred in follow-up periods of two to eight years.

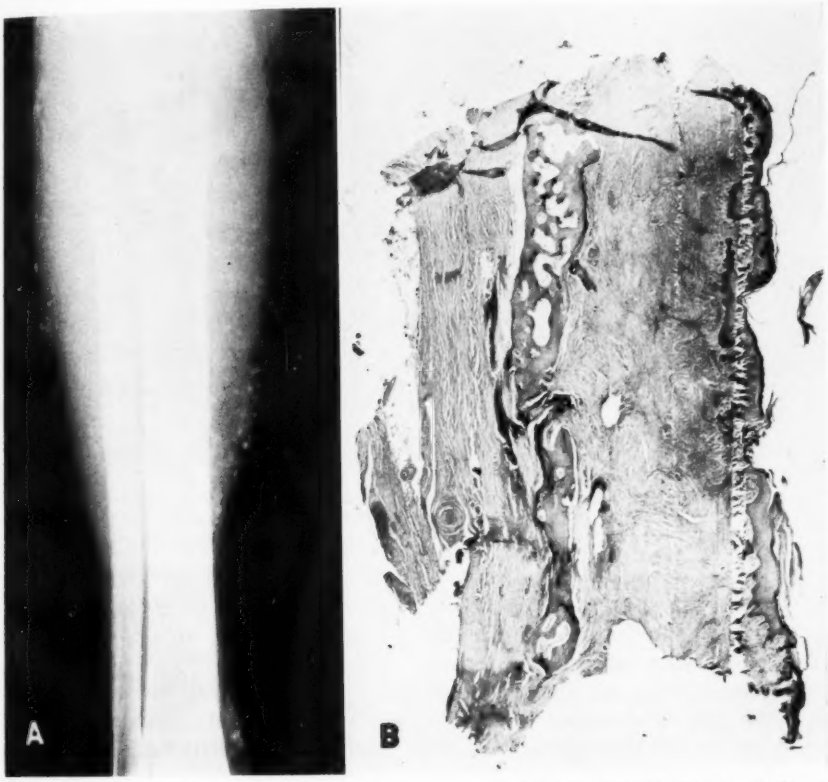

Fig. 7. Case IV. A. Left leg, two years postoperative, showing surgical defect at the lower medial aspect.
B. Section through entire thickness of removed specimen showing skin, scar tissue, and subcutaneous bone in successive layers. (×12)

It should be noted, however, that during removal of subcutaneous bone, extensive vein ligation and stripping has also been carried out, thus contributing to the control of orthostatic edema, which we believe to be one pathogenetic factor in heterotopic subcutaneous bone formation (9). It is therefore not certain at present whether subcutaneous ossification occurs over short or long periods of time or whether it is a continuous or a limited process.

Venography demonstrated the extravascular nature of the bony deposits. From a radiographic point of view, one cannot be certain that some of the calcific densities are not within a vein which has been completely occluded and, therefore, does not fill with contrast medium. At surgery and on pathologic examination, however, the veins were not found to be involved by ossifications. Bone tissue was present in those areas of the subcutaneous layer which showed also dense fibrosis, venous stasis, and chronic cellulitis.

Pathologically, the heterotopic tissue consisted of cancellous bone in plates or rings, in the center of which were fat cells.

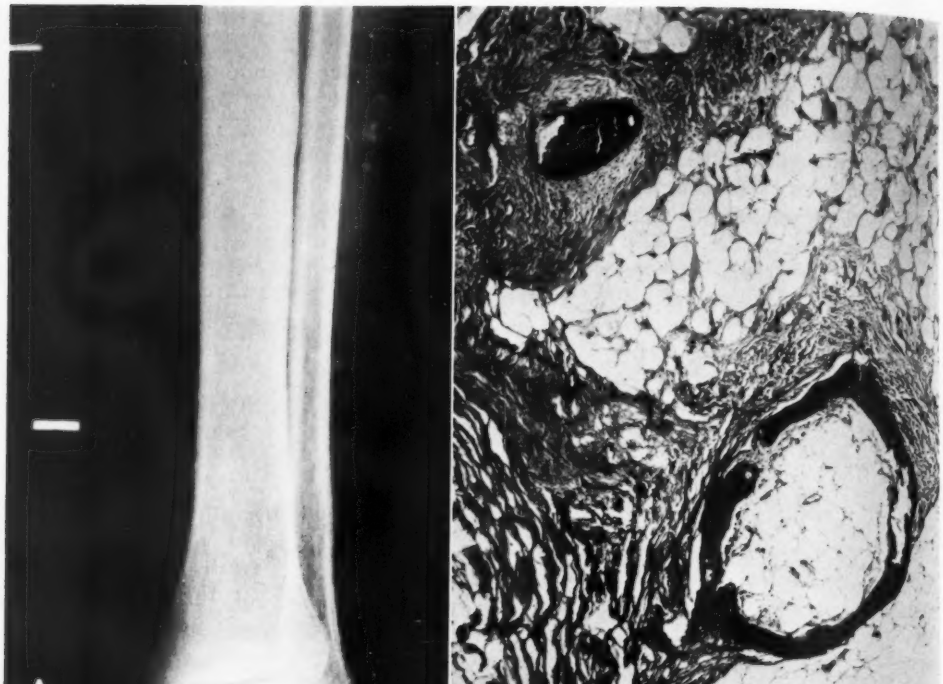

Fig. 8. Case V. A. Left leg, following vein ligation with removal of some subcutaneous tissue containing bone. B. Section showing subcutaneous bone in relation to fat and scar tissue. (×25)

In one case, bone-marrow cells were seen. No cartilaginous tissue was encountered. No ossification was found within the lumen or wall of a vein. In some instances, phleboliths were seen in the histologic picture, consisting of amorphous mineral deposits in the wall of the vein; no transition could be demonstrated between these calcific deposits and the extravascular heterotopic bone tissue.

The pathogenesis of subcutaneous ossification is being studied at this time (9). No disturbance in systemic calcium and phosphorus metabolism could be demonstrated in this series. Heterotopic bone in chronic venous insufficiency is apparently formed by a local process and represents a metaplasia of one of the cellular elements of the subcutaneous tissue into viable bone. A presumptive suspicion that ossification occurs as a result of fat necrosis with calcification is not borne out by our observation. No evidence of fat necrosis was noted in the available pathologic material. In some of the thicker bone plates, haversian systems were present, probably related to nutritional requirements. In thinner bone plates, no such arrangements were observed. Osteoblastic and osteoclastic activity was noted, suggesting stress and strain rearrangements, and illustrating the viability of the heterotopic bone laid down in the subcutis.

Periosteal changes of the fibula and tibia have been reported in chronic venous insufficiency (10, 11). The pathogenesis of this phenomenon is not known. In our series, there was no direct correlation between the sites of periosteal new bone formation and venous stasis or dependent edema. In many cases, periosteal new bone formation was present along the entire shaft of the fibula, whereas venous stasis was confined to the lower third of the

leg. Subcutaneous ossification appeared to represent a *de novo* metaplasia from cells in the fatty subcutaneous tissue and not related to or an extension of periosteal new bone, as has been noted in other sites of extraskeletal ossification (12). In 40 per cent of the cases of subcutaneous ossification, there was no evidence of periosteal new bone formation. The correlation between periosteal new bone formation and various types of venous pathology is at present being studied (13).

Subcutaneous ossification is often associated with recurrent ulceration (Table I), more so than chronic venous insufficiency without subcutaneous ossification. The greater incidence of ulcers in these cases is not due to the presence of subcutaneous bone *per se* but rather to the greater difficulty in controlling edema in the presence of bone in the subcutis. Surgical removal of an ulcerated area including subcutaneous underlying bone will result in permanent healing, provided the edema is controlled concurrently. This may be achieved by medical or by surgical means.

Recurrent or non-healing ulcers in a leg with chronic venous insufficiency should alert the clinician to the possible presence of subcutaneous bone in the ulcerated area. This can be confirmed by palpation and by roentgenography.

The role of epidermophytosis in the pathogenesis of subcutaneous ossification of the legs, if any, remains to be determined.

DIFFERENTIAL DIAGNOSIS

The most common densities which can be confused with subcutaneous ossification are phleboliths. A phlebolith, however, is usually more discrete and presents a smoother outline; it generally has a denser rim with a smaller central zone of lucency. Furthermore, multiple phleboliths usually remain discrete, while ossifications tend to coalesce. In some cases the distinction cannot be made clearly on the basis of the appearance of the densities, but venography may be of help.

Arterial calcifications are more linear, frequently show a double-tracked appearance, and are present in the deeper soft tissues of the leg.

Myositis ossificans can be differentiated not only by the appearance of the ossification but more clearly by its position within muscle rather than subcutaneous tissue.

Calcifications of infestations, periarticular ossification associated with disease of the spinal cord, various forms of calcinosis, calcification within localized areas of trauma and necrosis, and Ehlers-Danlos syndrome may occasionally give rise to questions of differentiation. Careful evaluation of the calcific densities correlated with the clinical picture will in most cases lead to the proper diagnosis.

SUMMARY

1. Subcutaneous ossification of the legs is a frequent late complication in chronic venous insufficiency. A series of 60 cases is reported.

2. The roentgenographic appearance of the ossifications varies according to the amount and extent of involvement:

(*a*) Fine granular densities.
(*b*) Delicate oval or cylindrical densities which may interlace and coalesce. These densities frequently show thin rims and lucent centers which may have a fine web-like pattern.
(*c*) Heavy cords and sheets which may retain central lucent zones. Trabeculation can sometimes be demmonstrated.

3. The subcutaneous location of the ossifications can be demonstrated by laminagraphy, which shows no involvement of skin and underlying muscle.

4. The ossifications are independent of veins. This is demonstrated by venography and examination of pathological material.

5. The differential diagnosis is discussed.

ACKNOWLEDGMENTS: Dr. Lent C. Johnson (Armed Forces Institute of Pathology, Washington, D. C.) interpreted the pathologic material and furthered the work here presented by his stimulating interest.

Figures 4 D and E, 5 B and C, 7 B, and 8 B are photographs of micromixes prepared by the Medical Illustration Department of the Armed Forces Institute of Pathology, Washington, D. C. Drs. Harry M. Zimmerman, William C. Antopol, and C. Solomon permitted the use of some of the pathologic specimens obtained in their hospitals. Drs. Allan Bloomberg, Seelig Freund, and Bernard Simon performed the surgical procedures.

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SUMMARIO IN INTERLINGUA

Ossification Subcutanee del Gambas in Chronic Insufficientia Venose

Ossification subcutanee del gambas es un frequente complication tardive in chronic insufficientia venose. Un serie de 60 casos es reportate.

Le manifestationes roentgenographic del ossification varia secundo le grado e le extension del phenomeno. In casos in que le ossification esseva leve, su recognition esseva difficile. In tal casos, le ossification se manifestava como maculas de densitate augmentate le quales monstrava frequentemente, quando illos esseva magnificate, un delicate margine circum un centro que esseva plus lucente. Le densitates esseva diverse in lor conformation, sed in le majoritate del casos illos esseva ronde o oval e a vices cylindric. Interconnexiones esseva frequente, resultante in un conformation alveolar. In casos plus marcate le margines esseva plus prominente, e le interconnexiones, attingente un stato de coalescentia, habeva resultate in le formation de cordas e laminas. In le casos le plus marcate, le impression esseva un de trabeculation. A vices le laminas de osso circumdava un portion del gamba completemente.

Le location subcutanee del ossification pote esser demonstrate per laminographia. Isto rende visibile que le pelle e le subjacente musculo non es afficite. Le ossificationes es independente del venas. Isto es demonstrate per venographia e le examine de material pathologic.

Bilateral Synostosis of Seventh Rib and Scapula

A Case Report[1]

JAMES M. PACKER, M.D., ELMER J. HARRIS, M.D., and ROBERT P. HENDERSON, M.D.

CONGENITAL abnormalities of ribs are frequently noted on routine roentgenograms of the chest. With few exceptions, these are regarded as of little clinical significance. Among the types commonly encountered are: bifid anterior, hypoplastic and hyperplastic, cervical, and the group of synostoses and pseudoarthroses between adjoining ribs.

Congenital synostosis between a rib and the adjoining portion of the scapula has not been previously identified in our department. On reference to standard texts and appropriate literature over the past ten years we were unable to find any mention of this particular abnormality.

The following case is thought to be unique and possibly of general interest in that it demonstrates the presence of bilateral, symmetrical synostoses joining the 7th posterior ribs to the inferior scapular angles. In so far as could be determined, this abnormality was congenital in nature; there was no history of trauma, surgery, or infection as possible causal factors. Furthermore, this proved to be an isolated skeletal anomaly, there being no other osseous lesion elsewhere in the body.

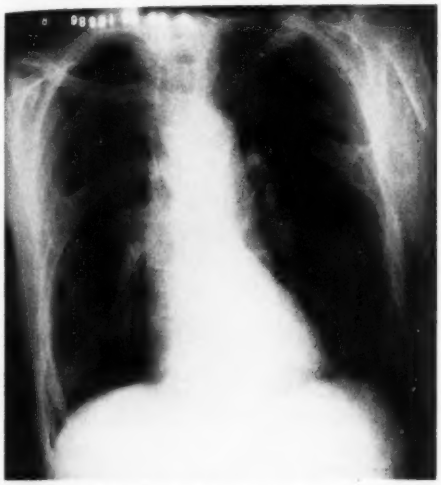

Fig. 1. Routine chest film showing expansion of the seventh rib bilaterally at the posterior axillary line.

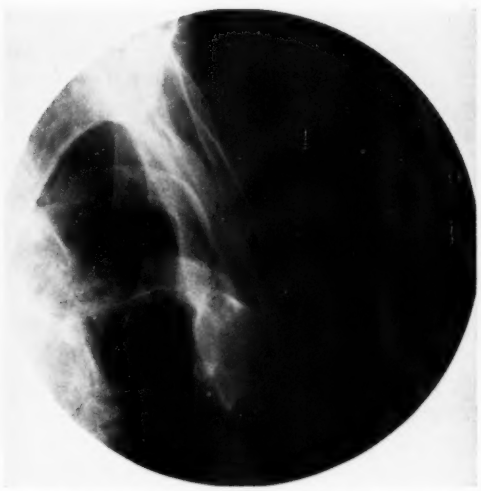

Fig. 2. Oblique film of scapula and adjoining chest wall, demonstrating synostosis of rib and scapula.

CASE REPORT

The patient was an 84-year-old white male contractor who was first admitted to the Mississippi Baptist Hospital in 1952. He was subsequently seen on five other admissions, the last one being in 1958, at which time he died during an episode of acute coronary insufficiency. His admissions were all related either to benign prostatic hypertrophy with retention or to coronary disease. On a routine erect chest film there was noted expansion of the seventh rib bilaterally at the posterior axillary line (Fig. 1). Oblique films of the scapula and adjoining chest wall demonstrated a thick bony bar joining the scapula and rib at this point (Fig. 2). No other skeletal abnormalities were detected on a bone survey.

The patient had led an active life as a building

[1] From the Department of Radiology, Mississippi Baptist Hospital, Jackson, Miss. Accepted for publication in March 1959.

contractor, with no significant disability from the bony abnormality. As would be expected, there was restriction of all motion of the shoulder and upper extremity involving scapular movement. There was a history of treatment for pernicious anemia for many years. During his twenties the patient had appendicitis with peritonitis, and at that time the rib abnormality was discovered on a chest radiograph made elsewhere.

SUMMARY

A case of bilateral, symmetrical synostosis joining the seventh rib to the scapula at its inferior angle is reported. This was an incidental finding and proved to be an isolated skeletal abnormality which was essentially asymptomatic. The only objective finding related to this condition was restriction of shoulder and upper extremity motion involving scapular movement.

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SUMMARIO IN INTERLINGUA

Synostosis Bilateral del Septime Costa con le Scapula: Reporto de Un Caso

Es reportate un caso de synostosis bilateral symmetric que establiva un junction inter le septime costa e le scapula a su angulo inferior. Le constatation esseva facite incidentalmente e se provava como un isolate anormalitate skeletic que esseva essentialmente asymptomatic. Le sol constatation objective relationate a iste condition esseva un restriction del motilitate del spalda e del extremitate superior in tanto que illo require un movimento scapular.

Osteochondromatosis of the Temporomandibular Joint[1]

JOHN H. FEIST, M.D., and T. G. GIBBONS, M.D.

OSTEOCHONDROMATOSIS denotes the presence of cartilaginous and osteocartilaginous bodies within or near a joint arising from the synovial membrane. The knee joint is the most frequent site, with the elbow next in order. Rarely, other joints may be involved. The purpose of this paper is to report a single case involving the temporomandibular joint proper. To the best of our knowledge no similar cases have been described, although osteochondromas of the coronoid process of the mandible and of the zygomatic arch have been reported (1–3).

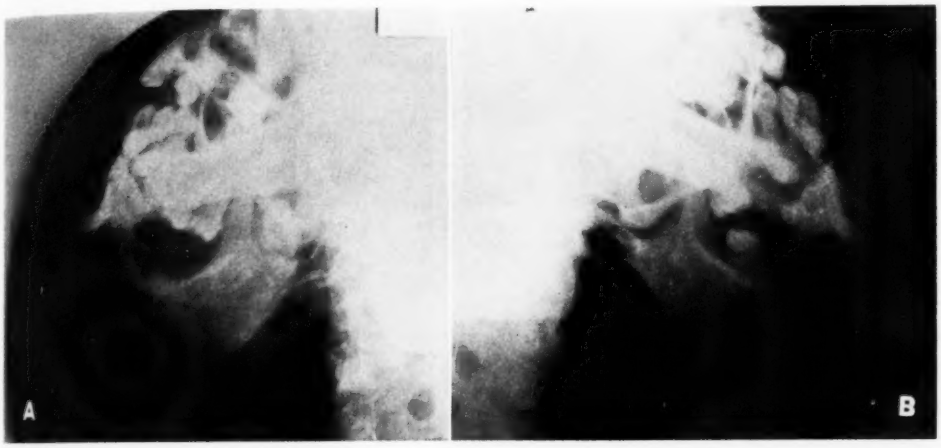

Fig. 1. Preoperative conventional lateral films. A. Right temporomandibular joint (only one large osteocartilaginous body is visible). B. Left temporomandibular joint (normal).

CASE REPORT

A 59-year-old white female was admitted to the Presbyterian Hospital of Pittsburgh on Sept. 21, 1956, complaining of pain in the right temporomandibular joint of one year duration. The pain, sharp and stabbing in nature, was present on chewing and yawning and was referred to the right ear and mastoid region. Extraction of a third molar tooth failed to afford relief, and the patient was readmitted on Dec. 13 with the same complaint as on her earlier admission. At this time, examination revealed a hard mass under the right temporal muscle. Pressure over this area produced discomfort but no real tenderness. Radiographs (Figs. 1 and 2) of the temporomandibular joints were obtained, and the report was as follows: "The condylar and coronoid processes of the right mandible appear intact. A calcified body is present in the joint space, and a second semicircular body is present in the space between the coronoid and condylar processes of the mandible. Scattered intervening calcifications are present. The left temporomandibular joint appears normal."

Surgical exploration was performed Dec. 29. A freely movable, loose body measuring 1.0 × 1.0 × 1.5 cm. was removed from the right temporomandibular joint. Subsequent histopathologic examination showed this to be osteocartilaginous in nature. A follow-up radiograph (Fig. 3) and laminagraph (Fig. 4) demonstrated persistence of the previously noted semicircular body between the coronoid and condylar processes, possibly slightly increased in its calcified portion and containing a radiolucent cartilaginous center; another smaller densely sclerotic body was interposed between the condyloid fossa and condylar process. The latter may represent either a recurrence of the previously excised lesion from its synovial origin, a small third body not discernible preoperatively, or the remnant of the base of the resected lesion.

[1] From the Department of Radiology, University of Pittsburgh School of Medicine and Presbyterian and Woman's Hospitals, Pittsburgh, Penna. Accepted for publication in March 1959.

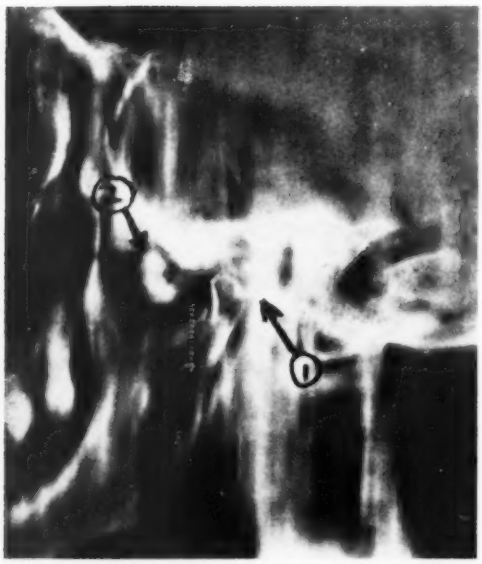

Fig. 2. Preoperative lateral laminagram of right temporomandibular joint. Note two separate osteocartilaginous bodies.

DISCUSSION

The etiology of osteochondromatosis is unknown. Many consider that the osteocartilaginous bodies arise from embryonic rests in the synovial membrane. The most widely held hypothesis within recent years regards the condition as a benign neoplasm (4), but Jaffe suggests the theory of metaplastic development from the "sublining connective tissue of the synovial membrane" (5). The formation of these bodies has been shown to follow the stages that occur in the embryonic formation of cartilage. As growth progresses, they usually become calcified and ossified, and are forced to the surface. Pedunculation results and, with rupture of the pedicles, the characteristic intra-articular loose bodies occur. The synovial membrane of the involved joint may be thickened and villous. Mussey and Henderson quote a number of authors who state that a single body may be produced in osteochondromatosis (4). The latter is difficult to prove, since loose bodies may also result from trauma. In many cases, definite proof of diagnosis will not be present because the synovial lesion may disappear completely, leaving one or more bodies and a normal membrane.

Osteochondromatosis should be clearly distinguished from benign osteochondroma(ta). Both lesions consist of osteocartilaginous tissue. By definition, an osteochondroma arises from chondral remnants in subarticular or metaphyseal areas and carries periosteum with it about all or part of its periphery. Hence there is definite distortion or deformity of the cortical bone at the site of origin, regardless of subsequent growth of the involved bone. An osteochondroma is truly a benign neoplasm and one or more of its components may undergo malignant change.

In contrast, osteochondromatosis, by definition, arises from the synovial membrane and may consist of one or more osteocartilaginous bodies not related to adjacent bony parts and therefore not associated with cortical distortion. Theories concerning pathogenesis have been discussed above. Malignant change of osteochondromatosis has not, to our knowledge, been reported, but we know of no absolute reason why it should not occur.

We believe that our case satisfies the criteria for osteochondromatosis. The roentgen examination revealed the presence of two calcified bodies associated with the right temporomandibular joint, one of which was excised and proved to be osteocartilaginous. Although the mandible is formed by membranous ossification, cartilaginous elements exist in portions of its mass, and particularly in the articular areas. Osteochondromata can therefore occur. Osteochondromatosis requires only the presence of synovial tissue, but the occurrence of cartilage in the area renders chondral metaplasia or migration of chondral rests along the synovia more plausible. The absence of any evidence of bony or cortical deformity in the vicinity of the osteocartilaginous bodies indicates that they represent osteochondromatosis rather than multiple osteochondromata. The temporomandibular synovial mem-

brane is a rather ample sac, especially anteriorly, and the larger anterior body adjacent to the mandibular process of the temporal bone in the case reported here may well have originated from the internal synovial surface. Its gradual enlargement had either caused stretching of the surrounding membrane or perforation through the investing synovial layer. This body was not seen during surgical exploration and hence was not removed, since it

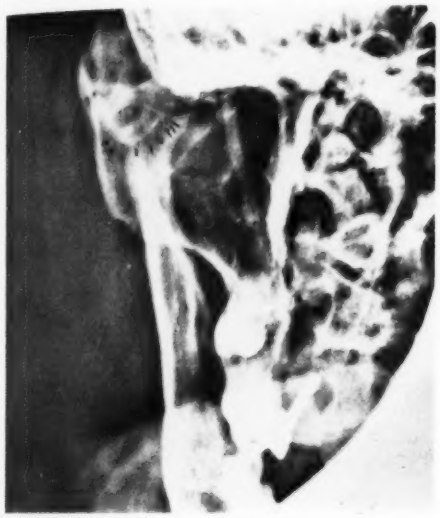

Fig. 3. Postoperative anteroposterior projection of right temporomandibular joint.

lay hidden beneath the zygoma. It is not certain, furthermore, that this body produced significant symptoms, although its size exceeds that of the more strategically located intra-articular body.

The roentgen diagnosis of temporomandibular joint lesions often lacks accuracy and their localization is ambiguous. At best, radiography of this area is difficult because of the various overlapping osseous shadows. It seems logical that patients with pain and limitation of motion of the temporomandibular joints who continue to have symptoms not fully explained by conventional roentgenography are candidates for laminagraphic examination. No other simple method presently available

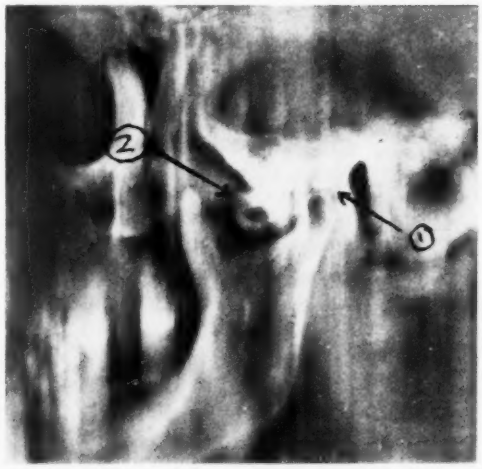

Fig. 4. Postoperative lateral laminagraph of right temporomandibular joint. Note small residual sclerotic loose body (1) and the larger anterior osteocartilaginous body (2) also well shown on conventional film.

allows such clear visualization of these joints.

SUMMARY

1. A case of osteochondromatosis of the right temporomandibular joint has been presented. To the best of our knowledge, this is the first example of osteochondromatosis to be reported in this location.

2. The theories of the pathogenesis of osteochondromatosis have been briefly reviewed.

3. The importance of laminagraphy in obscure conditions of the temporomandibular joint has been emphasized.

NOTE: The authors express their appreciation to Dr. A. H. Colwell for permission to use his case material.

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SUMMARIO IN INTERLINGUA

Osteochondromatosis del Articulation Temporomandibular

Le termino osteochondromatosis suggere le presentia de corpores cartilaginose e osteocartilaginose intra un articulation o proxime a illo e partiente ab le membrana synovial. Le genu e le cubito es le articulationes que es interessate le plus communmente. Le autores reporta lo que es, secundo lor informationes, le prime exemplo de osteochondromatosis del articulation temporomandibular. Le examine roentgenologic revelava le presentia de duo calcificate corpores in association con le articulation. Un de illos esseva excidite e esseva de natura osteocartilaginose. Le altere non esseva notate durante le exploration chirurgic proque illo esseva celate infra le zygoma. Le examine roentgenographic post le operation revelava ancora un tertie corpore sclerotic. Isto representava possibilemente un recurrentia o habeva simplemente escappate al observation in le studio pre-operatori.

Le radiographia del region temporomandibular es facilemente elusive e confuse a causa del coincidentias partial del umbras ossee. In tal casos, laminographia es de valor. Nulle altere procedura provide un visualisation similemente clar de iste articulationes.

Subpleural Lipoma[1]

EDWARD A. TEN EYCK, M.D.

LIPOMAS, WHICH are relatively common in the subcutaneous tissues, occur only rarely in the thoracic cavity. In this position, they are usually related to the mediastinum (6, 7, 8, 12). Even rarer is the occurrence of subpleural or parietal tumors unconnected with the mediastinum.

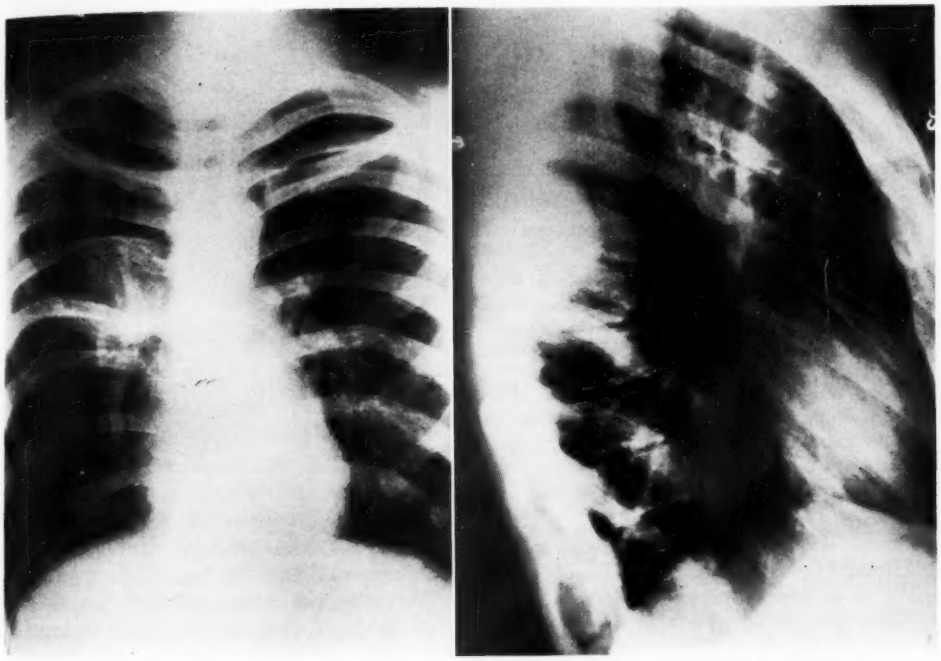

Fig. 1. Case I. Lipoma of posterior chest wall with widening of the right sixth rib interspace.

Three such cases were treated in The New York Hospital during the past five years.

CASE REPORTS

CASE I (Fig. 1): A 14-year-old white boy was admitted to the hospital because of an abnormal routine chest film, which had been taken two weeks previously. It demonstrated a 4 × 7 × 8-cm. density in the right posterior chest wall, opposite the sixth rib interspace. There was localized widening of the rib interspace with attenuation of the adjacent sixth and seventh ribs. On physical examination, a firm, nontender, 4 × 4-cm. mass was found to the right of the spine at the midscapular level, corresponding in position to the density on the chest film. At operation a large, yellow, fatty, dumbbell-shaped mass was found, extending from outside the chest wall through the sixth interspace into the posterior thoracic cavity. The entire mass was excised, and the pathological report was lipoma.

CASE II (Fig. 2):[2] A 72-year-old white woman was admitted to the hospital without complaints. Two weeks prior to admission she fell, and roentgenograms were taken of the right shoulder for possible fracture. There was no evidence of bone injury, but a density was fortuitously discovered in the right chest. It measured 2 × 3.5 cm. and was adjacent to the lateral chest wall.

Exploratory thoracotomy was undertaken and revealed a yellow, encapsulated, subpleural mass. Its base was in the intercostal space but did not penetrate it. The mass was resected and the pathological report was lipoma.

[1] From the New York Hospital, New York, N. Y. Accepted for publication in March 1959.

[2] Reported by permission of Dr. Laurence Miscall.

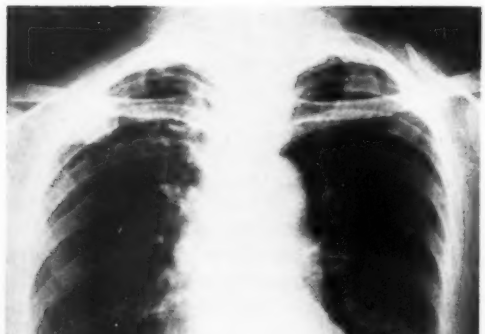

Fig. 2. Case II. Lipoma of right upper chest wall.

CASE III (Fig. 3): A 69-year-old white woman was admitted to the hospital for a retinal detachment. A routine chest film revealed a 3.5 × 4-cm., sharply circumscribed density in the left upper lung field adjacent to the lateral chest wall. A left thoracotomy was performed and a soft subpleural mass was found bulging into the pleural cavity. The mass, which did not penetrate the rib interspace, was completely removed. The pathological report was lipoma.

DISCUSSION

Heuer (6, 7) divided intrathoracic lipomas into three groups: (*a*) hourglass tumors consisting of an intrathoracic and extrathoracic mass connected by a thin isthmus perforating the thoracic wall between the ribs; (*b*) anterior superior mediastinal masses which extend up into the root of the neck, presenting as visible and palpable tumors; (*c*) wholly intrathoracic masses, which are most commonly related to the mediastinum.

Those masses separated from the mediastinum have been designated as subpleural lipomas and may be located beneath the costal or diaphragmatic pleura (2, 13). They are rare in the latter location. For completeness, endobronchial and pulmonary lipomas should be included in the last group (*c*).

Most intrathoracic lipomas are discovered on routine chest examination as asymptomatic densities. Usually symptoms occur only when the mass attains considerable size, with resultant pressure and interference with the contiguous cardiopulmonary structures. Pain is rare unless there is pressure on a nerve.

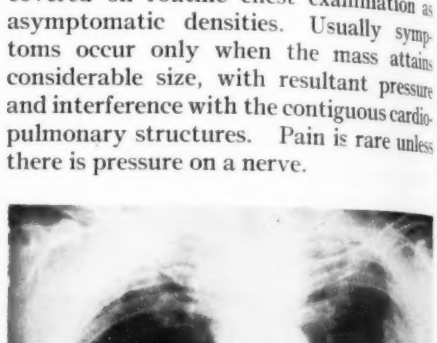

Fig. 3. Case III. Lipoma of left upper chest wall.

Lipomas consist of lobules of normal adult fat separated by fibrous septa and surrounded by a thin, fibrous capsule. Some do not have a definite capsule and are not well demarcated from the surrounding tissue; these may be difficult to distinguish from normal fat. The fat of lipomas has the same chemical composition as normal fat. However, it does not partake in fat metabolism and is not utilized in emaciated patients.

Anterior mediastinal lipomas may also originate in the thymus, where they have been called lipothymomas (1, 4).

There have been several reports of intrathoracic tumors consisting of brown fat, which have been called hibernomas (5, 9, 10). It has been suggested that these are the homologues in man of the hibernating glands in animals. Shaw (11) found that, in the human fetus, axillary and subpleural

adipose originally consisted largely of brown fat in contrast to the yellow fat of subcutaneous tissues.

There is a dearth of information in anatomy books on the distribution of adipose tissue within the thorax. The extent of such tissue may bear some relationship to age, sex, and nutrition. Evander (3) reported 3 cases of parietal subpleural fat pads seen with therapeutic pneumothorax and reviewed the extensive German literature on the anatomy of endothoracic adipose tissue. Briefly, fatty deposits are most plentiful about the mediastinum and are scarce beneath the diaphragmatic pleura. In the parietal region, streaks of fat may occur between the ribs and pleura, but usually not over the rib interspaces.

On chest radiographs lipomas appear as well circumscribed areas of increased density, in contrast to adjacent aerated lung. The translucency of fat is exceeded only by that of air. When lipomas are located in tissues of denser structure, such as muscle, they appear as areas of decreased density. A margin of lesser density for a lipoma in the chest has been described. This finding, however, was not evident in our cases. Tomograms were taken on all patients, but did not provide any helpful information.

It is frequently difficult to determine whether chest lesions are located in the pleura or in the lung. A diagnostic pneumothorax will differentiate between the two.

The preoperative diagnosis of these tumors is unlikely unless there is an extrathoracic component. Differential possibilities include: pleural metastases, pleural fluid loculations, and primary pleural tumors.

SUMMARY

On rare occasions lipomas may occur beneath the parietal pleura and produce pulmonary densities. They are usually discovered on routine chest films in asymptomatic patients. The preoperative diagnosis is unlikely unless there is an extrathoracic component.

Lipomas should be considered in the differential diagnosis of pleural tumors.

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SUMMARIO IN INTERLINGUA

Lipomas Subpleural

Es rar le occurrentia de lipomas infra le pleura parietal, manifeste in le radiogramma como area de densitate augmentate per contrasto con adjacente pulmon aerate. Excepte quando illos ha attingite dimensiones considerabile e exerce un pression super le contigue structuras cardiopulmonar, illos es usualmente asymptomatic e se discoperi in roentgenogrammas thoracic obtenite pro altere rationes. Le diagnose pre-operatori es improbabile, excepte in le presentia de un componente extrathoracic.

Es reportate tres casos.

Simultaneous Lateral Placentography[1]

PLINIO ROSSI, M.D., JOHN RIZZI, M.D., and VICTOR DE SANTIS, R.T.

IN AN ATTEMPT to localize the placenta radiographically in the third trimester, notably in patients who have histories of bleeding or are proposed for cesarean section, we have tried a variety of technics. In our hands, these have met with varied success, and numerous advantages and disadvantages have been noted.

We were perplexed by our results with direct placentography by the so-called "soft-tissue technic," particularly the lateral view. Exposure sufficient to demonstrate the posterior uterine wall is usually too penetrating to delineate the anterior abdominal and uterine walls and the converse is also true. The necessity for two sets of films thus arises. The vagaries of sight development technic become pronounced except in experienced hands, which are not always available in all institutions. To overcome some of these handicaps, a number of authors have made use of wedge filters or differential intensifying screens. The former, however, are not readily available commercially and the latter require an adjusted cassette.

The method herein described was devised to overcome the aforementioned disadvantages without the use of special equipment or special technical assistance and to reduce the amount of roentgen radiation normally delivered to the patient by some other technics.

METHOD

A routine 14 × 17-inch cassette is loaded with three unexposed films and is used for the lateral view, being placed in such a manner as to include the entire uterus, the sacral promontory, and the symphysis pubis. The tube, at 40-inch target distance, with a 4-mm. aluminum filter and 0.5 mm. oil, is centered 5 cm. dorsally and caudally from the geometric center of the cassette. Thus, the central beam passes through the thickest portion of the patient's body. The exposure factors are 150 mas and from 100 to 110 kvp, according to the thickness of the part. The three films then receive standard processing for the same length of time.

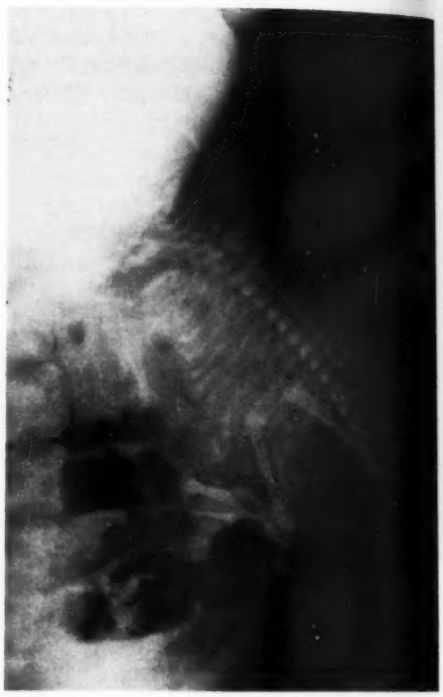

Fig. 1. Anterior film showing posterior uterine wall and its thickness. The fetus presents a normal development.

Upon development, the middle film is found to be sufficiently underexposed to demonstrate clearly the anterior uterine wall, while the others are sufficiently exposed to show the spine, the posterior uterine wall, and the pelvic bony structures. This occurs because all the films are differentially shielded from the full effect of the

[1] From Queens General Hospital, Jamaica, N. Y. (P. R., Resident in Radiology; J. R., Ex-Resident in Obstetrics; V. De S., Senior Technician). Accepted for publication in February 1959.

Fig. 2. Middle film showing the anterior abdominal and uterine walls and the site of placental insertion demonstrated by the considerable increase in thickness of uterine wall.

intensifying screens, the middle film on both sides and the others on one side only. One of the outer films can be left in the cassette and used repeatedly for subsequent examinations, since it acts only as a filter to absorb the fluorescence of the adjacent screen.

RESULTS

We have employed the above method in 25 consecutive cases in which placental localization was indicated for diagnosis and decision as to possible intervention. In no case where the placenta was in the anterior or posterior wall or in the upper uterine segment was there failure to localize it correctly (Fig. 1).

CONCLUSIONS

The advantages of this approach are the procurement, by a single exposure, of an accurate demonstration of both the anterior and posterior uterine walls on films free of artefacts, reduced exposure of the patient to roentgen rays, and avoidance of special equipment or technical assistance.

NOTE: The authors express their appreciation to Dr. A. V. Shapiro, Chief of the Radiologic Department, and Dr. Edward C. Veprovsky, Chief of the Obstetrical Service, Queens General Hospital, for their co-operation and encouragement.

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SUMMARIO IN INTERLINGUA

Simultanee Placentographia Lateral

Es describite un methodo placentographic in que un sol cassetto de 14 per 17 pollices es cargate de tres pelliculas e placiate de maniera que le utero complete, le promontorio sacral, e le symphyse pubic es includite in un exposition lateral. Le tubo es centrate super un puncto 5 cm in direction dorsal e caudal ab le centro geometric del cassetta, de maniera que le fasce central passa per le plus spisse parte del corpore del patiente. Quando le tres pelliculas es disveloppate a duration equal, on trova que le secunde es sufficientemente sub-exponite pro demonstrar le pariete uterin anterior, durante que le prime e le tertie monstra le spina dorsal, le pariete uterin posterior, e le structuras ossee del pelve.

Le methodo esseva usate a bon successo in 25 casos pro localisar le placenta.

Increased Skin Tolerance to High-Voltage X-Radiation in Patients Given Methoxsalen: Clinical Observations on 30 Cases

CYRIL M. LEVIN, M.D., and ARNOLD J. BAJEK, M.D.

The relatively limited tolerance of overlying skin may seriously restrict the delivery of optimal amounts of x-radiation into deep tumors. Several devices have come into accepted usage in order to spare the skin from as much radiant energy damage as possible. The radiotherapist using high-voltage equipment (200 to 250 kv) is still constantly plagued by his inability to deliver optimal dosage to these tumors.

Early in 1958, S. W. Becker, Jr. (1, 2) reported that methoxsalen plus ultraviolet energy induced the following changes in skin: Morphologically, there appeared thickening, increased density, and increased adherence of the stratum corneum, with the formation of a structure resembling the stratum lucidum. Because of these changes, pigment was retained in the epidermis, with "tanning." Functionally, the remarkable finding was that at the end of a two-week experiment, *and six months later*, twice as much radiant energy was required to induce a minimal erythema in the skin area given methoxsalen plus ultraviolet as in the control area given ultraviolet exposure without the drug. This resistance to burning was impressive.

In the electromagnetic spectrum, the ultraviolet and roentgen bands are continuous, the far ultraviolet having wave lengths approaching the shorter, soft, or grenz-ray band. It seemed reasonable to wonder whether still higher energy from further out in the roentgen band, plus oral methoxsalen, could induce the self-protective changes in skin described by Becker. It is the purpose of this paper to report that skin tolerance to high-voltage roentgen exposures is substantially increased by giving methoxsalen to patients undergoing radiotherapy. Lack of toxicity of methoxsalen has been documented in numerous recently published studies (3–10).

MATERIALS AND METHODS

During the year from July 1958 to June 1959, 30 consecutive unselected white patients were treated. All were ambulatory and in good general condition. None had received previous radiation therapy and none had evidence of prior or present skin disease. Twenty-two were females, 8 were males. The average age was fifty-nine years. Thirteen were of light, 11 of average, and 6 of moderately dark complexion.

Of the 30 patients, 12 were treated for pelvic cancers, 9 for breast cancer, 5 for pulmonary cancer, and 4 for malignant lymphomas.

The system of radiotherapy employed in this series was identical with that employed previously with the exception that each patient was given two tablets (20 mg.) of methoxsalen[1] two and a half to three hours prior to each of the first 14 treatments. Technical factors were as follows: 200 kv, 1.6 mm. Cu h.v.l., 50 cm. distance.

Dependent upon the anatomic site and character of the disease treated in each patient, portals varied in number from two to six and in size from less than 100 to 400 sq. cm. Two portals were treated at each visit, usually five times weekly, for from five to seven weeks, alternating portals where feasible and desirable. The air dose was 200 r to each of two portals. Wherever possible, tissues were compressed to the maximum in order to increase depth dose, and more treatments were administered to portals closer to the site of disease than to those further removed. Total skin doses to major ports (frequently the port receiving most radiation) varied from a low of 1,820 r to a high of 7,000 r, with an average of 4,700 r. Total tumor doses ranged from 3,000 r to 5,400 r, with a mean of 4,070 r.

RESULTS AND OBSERVATIONS

Of these 30 patients, 9 had no desquamation or only insignificant flaking, 14 had moderate dry desquamation, and 7 had moist desquamation (for the most part in the axilla, groin, and pendulous abdominal folds).

However the drug-plus-energy complex acts, there is no uncertainty as to the increase in skin tolerance to high-voltage x-rays. This was estimated to be approximately 25 per cent. This seems reasonable, since the average of the total skin doses was 15 to 20 per cent higher than previously attainable, and only 25 per cent of these patients showed any degree of moist desquamation in contrast to over 75 per cent of those previously treated. This is of practical value in terms of administering more x-ray energy into the tumor area with less discomfort to the patient.

In those patients with visible, palpable, or radiographically definable tumors, response of the tumor to irradiation proceeded as expected. In each case tumor regression followed the expected pattern in accordance with its degree of radiosensitivity.

Radiation sickness was less frequent, percentagewise, and less intense than in previous similarly treated patients. Induration or thickening of skin and subcutaneous tissues was also less marked.

[1] The methoxsalen tablets used in this study were furnished by The Upjohn Company, Kalamazoo, Mich. The trade name is Meloxine.

Currently, methoxsalen is being given in 20 mg. doses to all patients through the entire course of radiotherapy with no evidence or indication of toxicity.

Experiments are being undertaken designed to determine alteration in radiosensitivity of skin, deeper tissues, and tumors of test animals with and without methoxsalen, utilizing the index of mitotic counting.

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EDITORIAL

Theodore John Wachowski, M.D.

President of the Radiological Society of North America

Leadership, professional ability, and a vibrant personality characterize the newly elected President of the Radiological Society of North America, Dr. Theodore John Wachowski. "Ty," as he is known to his many friends, has served the Society in various capacities over the past years. As Chairman of the Committee on Commercial Exhibits, he devoted time and energy to arranging the annual meetings for many years. Because of his proved ability, he was drafted to act in a similar capacity for the Fifth Inter-American Congress of Radiology in 1955, his efforts contributing largely to the financial success of that meeting. He became a member of the Board of Directors of the Radiological Society in 1954 and later he served as its Chairman. Now he assumes the office of President.

Dr. Wachowski's entire life has been spent in the Chicago area. He received his early schooling in Chicago and later he attended the University of Illinois, where he received his B.S. and M.D. degrees. During this time he was actively engaged in sports and was a member of the track team that won the Big Ten Championship for three years.

An internship at the University of Illinois Research and Educational Hospitals was followed by a residency in radiology at that hospital under the direction and guidance of Dr. Adolph Hartung. Upon completion of his residency in 1935, Dr. Wachowski continued on the staff at the University of Illinois. He was acting head of the Department of Radiology from 1944 to 1947 and now continues as clinical professor under Dr. Roger Harvey. He has been a radiologist at the Copley Memorial Hospital in Aurora, Ill., since 1935, a position he still holds. He is past-president of the medical staff of that hospital.

Although "Ty" has devoted most of his life to radiology, he has nevertheless taken the time to play an active role in the field of general medicine. He has been Secretary and President of the Douglas Park Branch of the Chicago Medical Society, President of the Polish Medical Society of Chicago, and President of the Aurora Medical Society of Aurora, Ill.

Dr. Wachowski has served his specialty well, as is evidenced by his many activities in the field. He was Secretary and Chairman of the Section on Radiology of the Illinois State Medical Society, was President of the Chicago Roentgen Society, and is now an active member of its Board of Directors. He has worked for the American College of Radiology for many years—first as Chairman of the Commission on Legislative and Public Policy and later as an elected member of the Board of Chancellors. At present he is a member of the Executive Committee of the College. He is also a member of the American Roentgen Ray Society, the American Medical Association, and the Inter-American College of Radiology, beside holding memberships in many other organizations.

Dr. Wachowski has contributed many articles to the radiological literature, dating back to 1935 and continuing up to the present time. Many of his earlier papers were written in co-authorship with Dr. Hartung.

In 1931, Dr. Wachowski married Dr. Barbara Benda, a classmate at the University of Illinois. "Ty" and Barbara bought

THEODORE J. WACHOWSKI, M.D.
President of the Radiological Society of North America

the old Gary estate in Wheaton, Ill., a small suburb of Chicago. Their first few years in Wheaton were spent remodeling their home and landscaping the grounds. The Wachowskis belong to various local garden clubs and have won many blue ribbons. Their collection of roses and irises is the envy of their friends. "Ty's" many hobbies include golf, photography, hunting, traveling, accumulating mechanical gadgets, converting his wife's flower beds to grass, and then more golf. Barbara and "Ty" have a son, Ted, who is a sophomore pre-medical student at the University of Michigan. Ted acts as a hunting partner for his Dad during their various Canadian hunting trips.

In choosing "Ty" Wachowski as its President, the Society has selected a man with a dynamic personality and a tenacious desire to do an outstanding job in any task he undertakes. We can be proud of our choice.

FAY H. SQUIRE, M.D.
ELBERT K. LEWIS, M.D.

The Forty-Fifth Annual Meeting

The Forty-fifth Annual Meeting of the Radiological Society of North America was held in Chicago at the Palmer House, Nov. 15–20, 1959, with a record registration, well in excess of 3,000. The scientific program, arranged by the President, Dr. Laurence L. Robbins, and the Program Committee, was of great interest, as evidenced by the large attendance at all sessions. Two Sections, A and B, met simultaneously each morning, Tuesday through Friday, joining in a single session each afternoon, Monday through Thursday. A third Section, C, devoted to Physics, met Wednesday and Thursday mornings, with a special session Wednesday afternoon for the presentation of "recent advances in radiologic physics." An innovation this year was the inclusion of two similar sessions devoted to recent advances in radiologic diagnosis and radiotherapy, meeting Friday morning. The papers presented at these two sessions, along with those of the Wednesday afternoon Physics Section, appeared in the January issue of RADIOLOGY.

The Refresher Course Series, which has developed into one of the most important features of the annual meeting, met with the usual enthusiastic response. The courses opened on Sunday with a Therapy Information Session (Moderator, Dr. Milton Friedman) and a Session on Protection (Moderator, Dr. Richard H. Chamberlain) in the afternoon and the ever popular Film Reading Session (Moderator, Dr. John A. Evans) in the evening. Monday morning was devoted entirely to the Refresher Course program, and each morning thereafter courses were presented from 8:30 to 10:00, covering a wide variety of subjects.

The scientific program was formally opened on Monday at 2:00 P.M. After the usual formalities, Dr. Laurence L. Robbins gave his presidential address on "The Future of Radiology." Dr. Eugene P. Pendergrass of Philadelphia then introduced the Memorial Fund Lecturer, Dr. Lee B. Lusted of Rochester, N. Y., who spoke on "Logical Analysis in Roentgen Diagnosis." Another important paper read at this time was one by Dr. Leonard W. Larson of Bismarck, N. D., on "Medicine's Role in Prepaid Medical Care Plans and Insurance."

On Tuesday morning, Section A was devoted to diagnosis, while Section B heard a series of papers on biological subjects related to radiation therapy. The combined session in the afternoon covered both diagnosis and therapy and was largely attended.

On Wednesday morning, the Section A papers included several on "cineradiography," which is now occupying the interest of so many radiologists. Section B opened with a paper on "Splenic Portography" followed by a series of papers on

therapy, two of which were devoted to electron beam irradiation. During the same time Section C heard a series of papers on Radiation Physics as applied to therapy. In the afternoon Sections A and B again held a combined meeting, with Dr. Richard H. Chamberlain as moderator. This was largely given over to the subject of bone marrow transplants and total body irradiation. It attracted a large audience and created considerable interest. The remainder of the program was concerned with angiocardiography.

Dr. Frederick W. O'Brien receiving the Gold Medal of the Radiological Society of North America from President Laurence L. Robbins.

Most of the Section A papers on Thursday morning pertained to the skull and brain, while Section B had a most interesting series on therapy, including two on the untoward effects which sometimes follow irradiation. During this same period Section C, on "radiation physics," included papers on checking the radiation output of machines and radiation protection problems. In the afternoon, at the combined A and B Sections the first portion of the program was devoted to a study of radiation problems of the atomic age. The second portion was on diagnostic problems relating to the gastrointestinal tract.

Dr. Theodore J. Wachowski, incoming President of the Radiological Society of North America, receiving the Pfahler Gavel from Dr. Laurence L. Robbins, outgoing President.

As mentioned earlier, the Friday morning Sections were given over to short papers on new projects in diagnosis and therapy at present under way.

Following the plan which was adopted two years ago, the banquet, formerly held on Thursday night, was omitted and the evening was devoted to the Carman Lecture. This was delivered by Dr. Chester M. Jones of Boston, who gave an excellent clinical address entitled "Malnutrition Secondary to Impaired Intestinal Absorption." Following the address, Dr. Jones was presented with an illuminated scroll as a memento of the occasion. At this time, also, the Gold Medal of the Society was bestowed on Dr. Frederick W. O'Brien of Boston, in recognition of his long service to radiology: in its scientific aspects, as a teacher, and in the organizational work of the various societies of which he is a member. Dr. Robbins then performed his last official act as President, turning over the Pfahler Gavel to Dr. Theodore J. Wachowski, the incoming President. Dr.

Wachowski, in turn, presented Dr. Robbins with an illuminated scroll commemorating his term as President.

New officers of the society were announced as follows: President-Elect, H. Milton Berg, M.D., Bismarck, N. D.; First Vice-President, Cesare Gianturco, M.D., Urbana, Ill.; Second Vice-President, Ted S. Leigh, M.D., Emory University, Ga.; Third Vice-President, Juan A. del Regato, M.D., Colorado Springs, Colo.; Secretary-Treasurer, Donald S. Childs, M.D., Syracuse, N. Y.; Historian, Howard P. Doub, M.D., Detroit, Mich.; Member of the Board of Directors, Robert D. Moreton, M.D., Fort Worth, Texas.

Two other features of the meeting which call for attention are the Scientific Exhibits and the Commercial Exhibits. Dr. Everett L. Pirkey, Chairman of the Scientific Exhibits Committee, has prepared a report of the former, which follows. The Commercial Exhibits (Dr. John H. Gilmore, Chairman) were listed in the October 1959 issue of RADIOLOGY.

The foregoing is but an outline of a week that will be well remembered by all who were in attendance at the 1959 meeting. We congratulate Dr. Robbins, and the host of others who were concerned, on another outstanding meeting of the Radiological Society of North America.

The Scientific Exhibits

The Scientific Exhibits at the Annual Meeting in Chicago, Nov. 15–20, were of extremely high quality and one of the most popular features of the meeting. The Case of the Day this year was presented by the Department of Radiology of the Jefferson Medical College of Philadelphia, under the personal supervision of Dr. Roy R. Greening and Dr. Patricia Borns. There were a total of 50 exhibits covering the field of Radiology in its many and varied aspects, from Roentgen Diagnosis through Nuclear Medicine.

The following awards were made by the Secret Committee:

Clinical Investigation

Certificate of Merit

Fibrous Dysplasia. Roy Berry, M.D. (deceased, April 1959), H. ROBERT DUDLEY, M.D., WILLIAM H. HARRIS, M.D., Boston, Mass.

Total Anomalous Pulmonary Venous Drainage. THOMAS R. FRYE, M.D., BLANCA SMITH, M.D., WILLIAM H. R. HOWARD, M.D., Columbus, Ohio.

Soft-Tissue Alterations and Subtle Fractures at the Elbow. ALBERT M. KOHN, M.D., Stevens Point, Wisc.

External Supervoltage Irradiation in Infiltrating Carcinomas of the Urinary Bladder. LOWELL S. MILLER, M.D., AND JOHN H. GRIMM, M.D., Houston, Texas.

Honorable Mention

Iridium-192 in Cancer Therapy. J. ROBERT ANDREWS, M.D., HERMAN D. SUIT, M.D., STANLEY E. SNEIDER, M.D., ROBERT W. SWAIN, M.D., Bethesda, Md.

X-Ray Museum. JOHN M. DENNIS, M.D., AND JAMES J. STOVIN, M.D., Baltimore, Md.

A Simplified Method of Treatment Planning. LUCILLE A. DU SAULT, Detroit, Mich.

Idiopathic Periureteric Fibrosis. JOHN A. EVANS, M.D., THANE ASCH, M.D., JOHN PEARCE, M.D., PETER DINEEN, M.D., New York, N. Y.

Dose to Lens From Radiographic Procedures. ELIZABETH F. FOCHT, B.A., G. R. MERRIAM, JR., M.D., M. BARNES, B.A., J. EVANS, M.D., New York, N. Y.

An "All Shape" Diaphragm for Teletherapy Units. ROBERT S. LANDAUER, Ph.D., HYO BYUN, M.D., MARION F. MAGALOTTI, M.D., Chicago, Ill.

Urogenic Vertebral Osteomyelitis. ABRAHAM MARCK, M.D., ABRAHAM MELAMED, M.D., CHARLES R. MARQUARDT, M.D., JAMES W. PICK, M.D., Milwaukee, Wisc.

Angiocardiographic Findings in Congenital Heart Disease. WILLIAM T. MESZAROS, M.D., BENJAMIN M. GASUL, M.D., PEDRO BICOFF, M.D., EGBERT H. FELL, M.D., JOSHUA LYNFIELD, M.D., RENE A. ARCILLA, M.D., GERSON O. DUARTE, M.D., LAWRENCE L. LUAN, M.D., Chicago, Ill.

Fundamental Investigation

Cum Laude

Liver Scanning. JAMES H. CHRITSIE, M.D., WILLIAM J. MACINTYRE, Ph.D., G. GOMEZ

CRESPO, M.D., WILLIAM B. CHAMBERLAIN, M.D., Cleveland, Ohio

The Sphincteric Function of the Uterine Isthmus: Its Role in the Diagnosis of Cervical Incompetence. DAVID BRUCE HAYT, M.D., EDWARD C. MANN, M.D., WILLIAM MCLARN, M.D., New York, N. Y.

The Difference in Response of Normal and Grafted Skin to Irradiation: A Clinico-Experimental Study. PHILIP RUBIN, M.D., JERRY GRISE, M.D., LESTER CRAMER, M.D., ANATOL RYPLANSKY, M.D., Rochester, N. Y.

The other exhibits shown were as listed below.

Midgut Volvulus. ROBERT P. ALLEN, M.D., DAVID R. AKERS, M.D., CHARLES E. SHOPFNER, M.D., Denver, Colo.

Metastatic Rhabdomyoblastoma in the Growing Skeleton. MELVIN H. BECKER, M.D., JOHN CAFFEY, M.D., DOROTHY H. ANDERSON, M.D., New York, N. Y.

Disease Conditions in Animals Common to Man. W. D. CARLSON, D.V.M., Fort Collins, Colo., AND S. A. PATTERSON, M.D., Denver, Colo.

Diagnosis of Pericardial Disease by Gas and Opaque Contrast. BARBARA L. CARTER, M.D., HERBERT M. STAUFFER, M.D., JACOB ZATUCHNI, M.D., LOUIS SOLOFF, M.D., Philadelphia, Penna.

Industrial Radiography—A Tool for Quality Control. NELSON B. CARTER, M.S., Rochester, N. Y.

Selective Angiography of the Left Heart, Aorta, and Coronary Arteries. CHARLES T. DOTTER, M.D., Portland, Ore.

The Sacroiliac Region. DAVID E. EHRLICH, M.D., CHARLES J. SUTRO, M.D., OTTO FLIEGEL, M.D., MORRIS WITTEN, M.D., Brooklyn, N. Y.

Expanding Radium Applicator—Cancer of the Uterus. EDWIN C. ERNST, M.D., St. Louis, Mo.

Subchondral Cysts: A Clinical and Experimental Study. E. BURKE EVANS, M.D., G. W. N. EGGERS, M.D., JAMES K. BUTLER, M.A., JOHANNA BLUMEL, Ph.D., Galveston, Texas.

The Bones of the Hand as a Mirror of Systemic Disease. JOHN H. FEIST, M.D., AND ELLIOTT C. LASSER, M.D., Pittsburgh, Penna.

Roentgenographic Findings in Wilson's Disease. NATHANIEL FINBY, M.D., New York, N. Y.

Utilization of an Economical Field Limiter in Co-60 Teletherapy. RIDLEY M. GLOVER, M.D., Atlanta, Ga.

Intravenous Aortography. RICHARD H. GREENSPAN, M.D., EUGENE F. BERNSTEIN, M.D., MERLE K. LOKEN, Ph.D., Minneapolis, Minn.

Roentgen Diagnosis of Acoustic Neuromas. SAMUEL HAVESON, M.D., AND ALFRED L. SCHMITZ, M.D., San Francisco, Calif.

Roentgen Complications of Selective Angiocardiography. THEODORE F. HILBISH, M.D., AND JEAN R. L. HERDT, M.D., Bethesda, Md.

Serial Femoral Arteriography in Occlusive Disease: Clinical-Roentgenologic Considerations. HAROLD G. JACOBSON, M.D., HENRY HAIMOVICI, M.D., JEROME H. SHAPIRO, M.D., New York, N. Y.

Spalteholz's Transparent Skull. JESSE T. LITTLETON, M.D., Sayre, Penna., AND LEWIS E. ETTER, M.D., Pittsburgh, Penna.

The Role of the Ileocecal Valve in Obstructions of the Large Bowel. LEON LOVE, M.D., Chicago, Ill.

Pulmonary Hydatid Cysts. RAFIC E. MELHEM, M.D., AND A. K. FREIMANIS, M.D., Columbus, Ohio

Pulmonary Vasculature in Rheumatic Heart Disease. ROBERT S. ORMOND, M.D., AND ANDREW K. POZNANSKI, M.D., Detroit, Mich.

Roentgenographic Manifestations of Pulmonary Tularemia. EDWIN L. OVERHOLT, M.C., AND WILLIAM D. TIGERTT, M.C., USA, Frederick, Md.

Preoperative Lateral Laminagraphy of the Chest. ANTON M. PANTONE, M.D., MYRON MELAMED, M.D., FRANK MILLOY, M.D., HIRAM LANGSTON, M.D., Chicago, Ill.

An Integrated System for Handling Brachytherapy Devices. LEON PAPE, M.Sc., AND MELVILLE JACOBS, M.D., Duarte, Calif.

Expanding Lesions of the Cervical Spinal Cord. LESTER W. PAUL, M.D., AND ARTHUR CHANDLER, JR., M.D., Madison, Wisc.

Long Film Functional Ascending Phlebography of the Lower Extremity. STANLEY M. ROGOFF, M.D., AND JAMES A. DEWEESE, M.D., Rochester, N. Y.

Radiation Hazards in X-Ray Treatment: A Guide to Safe Practice. BERNARD ROSWIT, M.D., SOL M. UNGER, M.D., STANLEY J. MALSKY, M.Sc., CYPRIAN B. REID, B.Sc., Bronx, N. Y.

Leiomyoma and Leiomyosarcoma of Gastro-Intestinal Tract. HILDEGARDE A. SCHORSCH, M.D., AND HYO HYUN BYUN, M.D., Chicago, Ill.

Experimental Coronary Arteriography. WADE H. SHUFORD, M.D., AND W. H. SEWELL, M.D., Atlanta, Ga.

Medical Research Reactor. E. E. STICKLEY, Ph.D., Upton, L. I., N. Y.

A Rapid Pre-Calculated Dosimetry Method for 200 Kv Arc Therapy. JAMES E. TURNER, M.D., Chicago, Ill.

Roentgen Manifestations of Mesenteric Vascular Disease. C. C. WANG, M.D., AND J. D. REEVES, M.D., Boston, Mass.

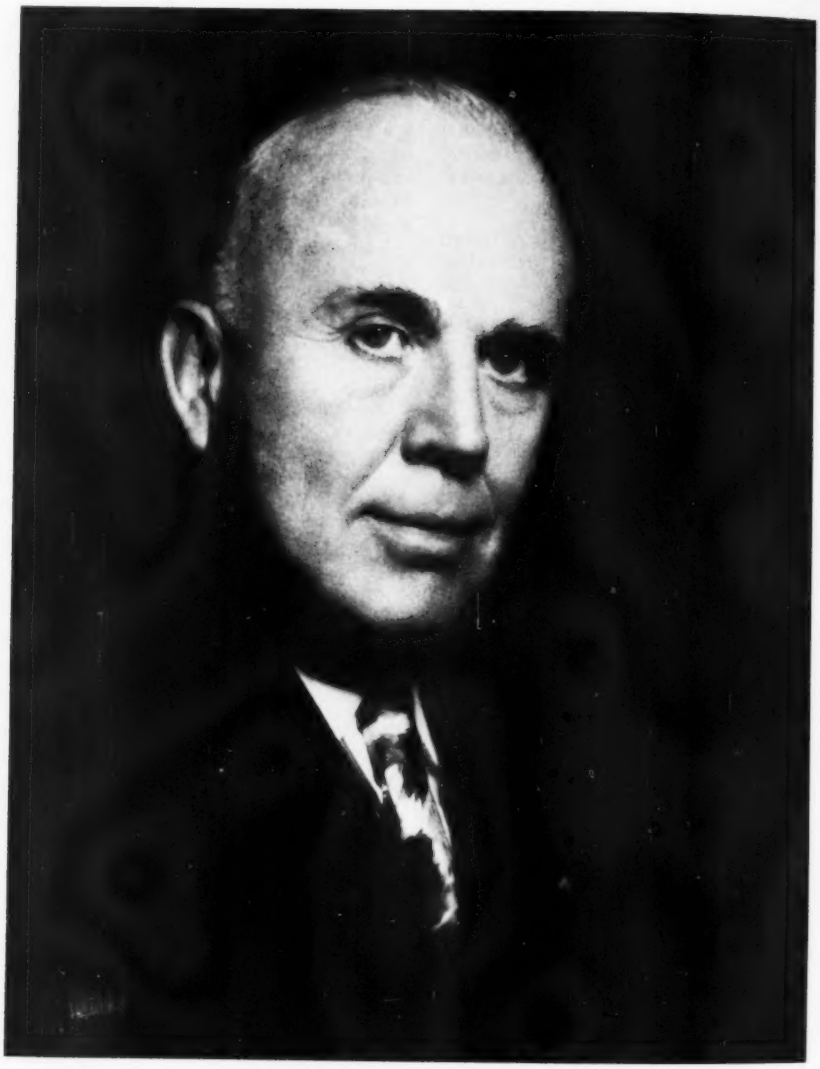
Yttrium^{90} Hypophysectomy Technic and Dosimetry Studies. JOSEPH L. WESTOVER, M.D., ROBERT W. RAND, M.D., M. A. GREENFIELD, Ph.D., Los Angeles, Calif.

Roentgen Problems in Paget's Disease. DANIEL WILNER, M.D., AND ROBERT S. SHERMAN, M.D., New York, N. Y.

The March Fracture of the Os Calcis. COLONEL PETER ZANCA, MC, USA, Fort Sam Houston, Texas, 1ST LT. NATHAN LAMAINA, MSC, Ft. Dix, N. J.; NATHAN A. CAMSON, DSC, Ft. Dix, N. J.

EVERETT L. PIRKEY, M.D.
Chairman

IN MEMORIAM



WILLIAM E. COSTOLOW, M.D.

1892–1959

Dr. William E. Costolow passed away on Nov. 22, 1959, at the age of 67 years, after a prolonged illness. He was born on June 13, 1892, in Kirksville, Mo., where he received his early education. He was graduated from the University of Missouri in 1913 and from the University of Pennsylvania Medical School in 1916. From 1919 to 1921, he served as a Fellow in Surgery at the Mayo Clinic. In 1921 he became an associate of the late Doctor Albert Soiland, in Los Angeles, and in the year 1930 joined in the formation of the firm of Soiland, Costolow, and Meland, which eventually became the Los Angeles Tumor Institute. During his active medical career Doctor Costolow specialized as a therapeutic radiologist, paying special attention to malignant disease.

Dr. Costolow was a Fellow of the American College of Physicians, the American College of Radiology, and the American Medical Association, as well as a Diplomate of the American Board of Radiology. He served as President and Trustee of the Los Angeles County Medical Association and President of the American Radium Society, and was active in the American Cancer Society. He was a member of the Radiological Society of North America and of the Los Angeles Radiological Society. He had been associated with the former Society since 1922.

He was on the staff of the California Hospital and St. Vincent's Hospital, was roentgenologist to the Santa Fe Coast Lines Hospital, and Attending Therapeutic Radiologist at the Los Angeles County Hospital. He was made Clinical Professor of Therapeutic Radiology at the University of Southern California in 1939, and became Professor Emeritus in 1958.

Dr. Costolow served his country in two World Wars, being discharged as a Captain in the United States Navy in 1945. He was a Past Commander of the American Legion, Albert Soiland Post. He also belonged to the University Club of Los Angeles, Al Malaikah Shrine of Los Angeles, Alpha Chi Sigma, Sigma Xi, and Phi Rho Sigma.

Many friends mourn his passing, his associates miss his presence, and members of the Radiological Society of North America and the American Radium Society, in particular, will remark his absence from their annual meetings.

ORVILLE N. MELAND, M.D.

ANNOUNCEMENTS AND BOOK REVIEWS

UTAH STATE RADIOLOGICAL SOCIETY

At a recent meeting of the Utah State Radiological Society, the following officers were elected: President, Philip R. Frederick, M.D., Salt Lake City; Vice-President, Harry J. Brown, M.D., Provo; Secretary-Treasurer, Richard Y. Card, M.D., St. Mark's Hospital, Salt Lake City 3; Councilor to American College of Radiology, Ralph R. Meyer, M.D., Salt Lake City.

ASSOCIATION OF RADIOLOGISTS OF PROVINCE OF QUEBEC

At a recent meeting of the Association of Radiologists of the Province of Quebec, the present Directors were re-elected for another year. The officers, all of Montreal, are as follows: Jean Bouchard, M.D., President; J. S. Dunbar, M.D., Vice-President; O. Raymond, M.D., 5400 West Blvd. Gouin, Montreal 9, Secretary; L. I. Vallée, M.D., Treasurer.

THE SOUTHWESTERN SOCIETY OF NUCLEAR MEDICINE

The Southwestern Society for Nuclear Medicine will meet March 25–26, 1960, at The Menger Hotel, San Antonio, Texas. Further details may be obtained from Dr. N. T. Werthessen, Program Chairman, Southwest Foundation for Research and Education, R. R. 4, Box 86, San Antonio 7, Texas.

UNIVERSITY OF CALIFORNIA COURSE IN DIAGNOSTIC RADIOLOGY

An intensive five-day course on Diagnostic Radiology will be presented March 16–20 at the University of California Medical Center in San Francisco, each day being devoted to a different subject to be explored in panel discussions, symposia, and film programs. The program director is Robert S. Stone, M.D., Professor of Radiology, and the program chairman is Howard L. Steinbach, M.D., Associate Professor of Radiology, University of California.

Further information may be obtained from Seymour M. Farber, M.D., Assistant Dean, Continuing Education in Medicine, University of California Medical Center, San Francisco 22, Calif.

THIRD INTERNATIONAL CONFERENCE ON MEDICAL ELECTRONICS

The Third International Conference on Medical Electronics will be held at Olympia, London, England, July 21–27, 1960, under the auspices of the Electronics and Communications Section of the Institution of Electrical Engineers, in association with the International Federation for Medical Electronics. With the many recent advances in both electronics and medicine, it is generally recognized by members of both professions that discussions on medical electronics can do much to stimulate progress.

Further information may be obtained from the Secretary, The Institution of Electrical Engineers, Savoy Place, London, W. C. 2, England.

PEPTIC ULCERS IN CHILDREN NATIONAL REGISTRY

A national registry for peptic ulcers in children has been instituted by Robert B. Tudor, M.D. Quain and Ramstad Clinic, Bismarck, N. D. He asks that cases proved pathologically or radiologically be reported to him. Reviews of the registry will be sent every six months to those who contribute to it.

DR. HOWARD P. DOUB HONORED

Dr. Howard P. Doub, editor of RADIOLOGY, was honored at a special dinner meeting of the Henry Ford Hospital Medical Society on Tuesday, Jan. 19, under the sponsorship of the Department of Radiology, with which he has long been associated. On this occasion a portrait of Dr. Doub, commissioned by his former students and other friends, was unveiled by the artist, Mr. Roy Gamble, and presented to the hospital by Dr. Glen Dobben under whose leadership the project had been carried out.

Dr. John A. Campbell, Professor of Radiology at Indiana University School of Medicine, and a former resident under Dr. Doub, addressed the group on the subject of "Thought Control in Roentgen Diagnosis."

CANCER CONTROL PROGRAM U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

The sum of $1,500,000 has been appropriated by Congress for the fiscal year 1960 for furthering the application of existing knowledge of the prevention and control of cancer. This fund is to be administered by the Cancer Control Program, Public Health Service, under the technical guidance of the National Cancer Institute.

It is believed that the best opportunities for demonstrating better ways of providing community cancer control services at this time lie along the following lines: professional and technical education in cytology; screening female beneficiaries of medical care for cancer of the cervix; public information and follow-up services, to stress the importance of periodic uterine cytologic examinations; professional educational activities emphasizing the importance of including diagnostic

aids in complete health examinations; selected public educational projects on the desirability of and need for examinations that maintain health; evaluation of effectiveness of public educational activities; tumor registries collecting data of exceptional value; extension and evaluation of rehabilitation programs (in co-operation with State rehabilitation agencies); selected programs demonstrating effective treatment for cancer in public beneficiaries of medical care. The types of projects suggested are not meant, however, to exhaust all possibilities. Other worthwhile, locally sponsored, and locally directed demonstration projects will be considered.

Announcement of the first nine grants made under this program, totaling $381,894, were made Dec. 30, 1959. Five of the projects will deal with tumor records and registries, two with screening of large numbers of women for cancer of the cervix, and two with education in cytology.

Applications, which are acceptable from nonprofit organizations and institutions as well as official health agencies, are reviewed in much the same way as requests for research grants at the National Institutes of Health. Additional information may be obtained from the Cancer Control Program, Division of Special Health Services, Department of Health, Education, and Welfare, Washington 25, D.C.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

ROENTGENOLOGIC DIAGNOSIS IN OPHTHALMOLOGY. By EDWARD HARTMANN, M.D., Chief of the Ophthalmic Department, Lariboisière Hospital and American Hospital in Paris, AND EVELYN GILLES, M.D., Chief of the Roentgenology Department, Quinze-Vingt Ophthalmic Hospital; Associate in Roentgenology, Saint Antoine Hospital and American Hospital in Paris. Translated by George Z. Carter, M.D., Assistant Professor of Ophthalmology, Albert Einstein College of Medicine. Edited by Conrad Berens, M.D., F.A.C.S., Lecturer on Ophthalmology, New York University Post-Graduate Medical School; Advisory Attending Surgeon, New York Eye and Ear Infirmary; Consultant Emeritus, American Board of Ophthalmology. A volume of 376 pages, with 497 figures. Published by J. B. Lippincott Co., Philadelphia, 1959. Price $15.00.

CINEFLUOROGRAPHY: PROCEEDINGS OF THE FIRST ANNUAL SYMPOSIUM ON CINEFLUOROGRAPHY, SPONSORED BY THE DEPARTMENT OF RADIOLOGY, UNIVERSITY OF ROCHESTER, SCHOOL OF MEDICINE AND DENTISTRY, ROCHESTER, NEW YORK, FRIDAY AND SATURDAY, NOVEMBER 14 AND 15, 1958. Edited by GEORGE H. S. RAMSEY, M.D., Professor and Chairman, JAMES S. WATSON, JR., M.D., Research Professor, THEODORE A. TRISTAN, M. D., Senior Instructor, SYDNEY WEINBERG, Research Associate, AND WILLIAM S. CORNWELL, M.A., Clinical Associate, all from Department of Radiology, University of Rochester, School of Medicine and Dentistry. A volume of 266 pages, with numerous figures. Published by Charles C Thomas, Springfield, Ill., 1960. Price $11.75.

MEDICAL X-RAY TECHNIQUE: PRINCIPLES AND APPLICATIONS. By G. J. VAN DER PLAATS, former Professor of Radiology, University of Groningen, Groningen, Netherlands. A volume of 480 pages, with 213 figures. Published by the Macmillan Co., New York, N. Y., 1959. Price $10.00.

THE TREATMENT OF BRONCHIAL NEOPLASMS. By ROBERT R. SHAW, M.D., AND DONALD L. PAULSON, M.D. With a chapter on Bronchial Adenoma by John Lester Kee, Jr., M.D. A monograph of 136 pages, with numerous figures. Published by Charles C Thomas, Springfield, Ill., 1959. Price $8.00.

PRINCIPLES OF RADIOISOTOPE METHODOLOGY. By GRAFTON D. CHASE, Ph.D., Associate Professor of Chemistry, Philadelphia College of Pharmacy and Science, with the co-operation of JOSEPH L. RABINOWITZ, Ph.D., Assistant Professor of Biochemistry, University of Pennsylvania. A volume of 286 pages, with numerous figures and tables. Published by Burgess Publishing Co., Minneapolis, Minn., 1959. Price $6.00.

THE YEAR BOOK OF RADIOLOGY (1959–1960 YEAR BOOK SERIES). RADIOLOGIC DIAGNOSIS. Edited by JOHN FLOYD HOLT, M.D., Professor, Department of Radiology, University of Michigan, AND WALTER M. WHITEHOUSE, M.D., Associate Professor, Department of Radiology, University of Michigan. RADIATION THERAPY. Edited by HAROLD W. JACOX, M.D., Professor of Radiology, College of Physicians and Surgeons, Columbia University; Chief, Radiation Therapy Division, Radiologic Service, Presbyterian Hospital, New York City, AND MORTON M. KLIGERMAN, M.D., Professor of Radiology and Chairman of the Department of Radiology, Yale University School of Medicine; Radiologist-in-Chief, Grace-New Haven Community Hospital. A volume of 446 pages, with 328 figures. Published by The Year Book Publishers, Inc., Chicago Ill., 1960. Price $10.50.

RADIATION BIOLOGY: PROCEEDINGS OF THE SECOND AUSTRALASIAN CONFERENCE ON RADIATION BIOLOGY HELD AT THE UNIVERSITY, MELBOURNE, 15–18 DECEMBER 1958, by THE AUSTRALIAN RADIATION SOCIETY. Editor: J. H. MARTIN. A volume of 304 pages, with figures and tables. Published by Academic Press, Inc., New York, N. Y., 1959. Price $11.00.

RADIATION BIOLOGY OF VICIA FABA IN RELATION TO THE GENERAL PROBLEM. By JOHN READ, B.Sc., Ph.D. The Hugh Adam Research Department of the Medical School and the New Zealand Branch of the British Empire Cancer Campaign, University of Otago, Dunedin, New Zealand. A volume of 270 pages, with 74 figures and 41 tables. Published by Charles C Thomas, Springfield, Ill., 1959. Price $10.50.

STRAHLENBIOLOGIE, STRAHLENTHERAPIE, NUKLEARMEDIZIN UND KREBSFORSCHUNG. Edited by H. R. SCHINZ, H. HOLTHUSEN, H. LANGENDORFF, B. RAJEWSKY, AND G. SCHUBERT. ERGEBNISSE 1952–1958. By G. BARTH ET AL. A volume of 998 pages, with 395 figures and 140 tables. Published by Georg Thieme, Herdweg 63, (14a) Stuttgart, Germany, 1959. Price DM 275.—($65.50). Distributed in United States and Canada by the Intercontinental Medical Book Corporation, New York 16, N. Y.

Book Reviews

THE ESSENTIALS OF ROENTGEN INTERPRETATION. By LESTER W. PAUL, M.D., Professor of Radiology and Chairman of the Department of Radiology, The University of Wisconsin Medical School, AND JOHN H. JUHL, M.D., Associate Professor of Radiology, The University of Wisconsin Medical School. A volume of 840 pages, with 1,203 illustrations. Published by Paul B. Hoeber, Inc., Medical Book Department of Harper & Brothers, New York 16, N. Y., 1959. Price $25.00.

This is an encyclopedic type of book devoted to the entire field of roentgen diagnosis. It follows that the coverage must of necessity be broad rather than deep. It is designed as a source of reference for the practicing physician, the postgraduate student, and medical undergraduate. It is authoritative, clearly written, and readable.

The text is divided into six sections as follows: Section I. The Osseous System; Section II. The Brain and Spinal Cord; Section III. The Abdomen and Gastrointestinal Tract; Section IV. The Urinary and Female Genital Tracts; Section V. The Chest; Section VI. The Face, Mouth, and Jaws. The descriptive material consists mostly of positive roentgen findings, with a minimum amount of discussion of associated conditions and clinical observations. Technical matters are dealt with in some connections. The fluoroscopic findings are described briefly where this method enters into the routine roentgen examination or where special studies are indicated.

The illustrations are well selected and reproduced in the positive phase, in a satisfactory manner. Most of the chapters contain a short bibliography of pertinent literature.

INTRACRANIAL CALCIFICATION. By FERMO MASCHERPA, Chief of the X-ray Department, Milan Neurological Institute, Milan, Italy, AND VINCENZO VALENTINO, Radiologist of the Institute of Semeiological Medicine, Naples University; Neuroradiologist of the Hospital "A Cardarelli," Naples, Italy. A monograph of 150 pages, with 98 figures. Published by Charles C Thomas, Springfield, Ill., 1959. Price $9.50.

This monograph on intracranial calcifications is made up of somewhat over 100 illustrations accompanied by a brief text in English. Though most of the cases are proved, a few are included in which the diagnosis was only presumptive.

Because of its brevity, the text adds little to previous publications. The wide variety of illustrative figures, however, make the volume worthwhile. The quality of the illustrations is adequate but undistinguished.

EINFÜHRUNG IN DIE RÖNTGENDIAGNOSTIK. By PROF. DR. U. COCCHI, Zurich, AND PRIV.-DOZ. DR. P. THURN, Bonn. A volume of 340 pages, with 547 illustrations on 419 figures. Published by Georg Thieme, Herdweg 63, (14a) Stuttgart, Germany, 1959. Distributed in United States and Canada by the Intercontinental Medical Book Corporation, New York 16, N. Y. Price DM 49.50.—($11.80).

The cover sheet and foreword state that this work is a students' manual, and the publication is entirely in this frame of reference. Conciseness is maximum, often at the expense of completeness. The initial chapter is a history of Roentgen's discovery of the x-ray and the subsequent major developments in medical roentgenology, with an interesting chronology. The second chapter covers, in a surprisingly full way, theory, technical considerations, injuries, and protection.

About 90 pages are devoted to the skeletal system and its diseases. One could question the position of pneumoencephalography and cerebral angiography under "the skull" in this chapter. The discussion of these important subjects is very incomplete, even considering the nature of the manual. There is also overemphasis on normal variants of bone and anomalies at the expense of coverage of diseases. About 100 pages are devoted to the diseases of the thorax, 70 to the gastrointestinal tract, 10 to the genitourinary tract, and the re-

mainder to various other areas of diagnosis. There is at least mention of most of the newer procedures (splenoportography, retroperitoneal air insufflation, etc.), although the discussion is necessarily limited.

As a text for medical students this should serve well, since the material could form a suitable basis for lectures. A resident would find the book of relatively small value, and the practicing radiologist of still less.

DIE BEWEGUNGSBESTRAHLUNG. By PROF. DR. F. WACHSMANN, apl. Professor für medizinische Physik, AND PROF. DR. DR. G. BARTH, apl. Professor für Strahlenheilkunde und physikalische Therapie, Universität Erlangen. A volume of 200 pages, with 150 figures. Published by Georg Thieme, Herdweg 63, (14a) Stuttgart, Germany, 2d ed., 1959. Distributed in the United States and Canada by the Intercontinental Medical Book Corporation, New York 16, N. Y. Price DM 46.—($10.95).

The authors treat the subject of moving-field therapy from every aspect, beginning with detailed discussions of physical and technical problems and going on to a full description from a clinical standpoint, covering radiation conditions, dosage, practical application, and treatment of particular tumors. Their knowledge is not limited to the utilization of conventional x-ray units, but includes also the use of high-energy accelerators such as betatrons, linear accelerators, resonance transformers and Van de Graaff generators, and teletherapy units loaded with radioactive materials.

The book is well organized and contains an extensive list of reference sources. Anyone dealing with moving-field therapy will benefit from its perusal.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

The Chest

The Heart and Blood Vessels

The Digestive System

The Musculoskeletal System

Gynecology and Obstetrics

The Genitourinary System

Miscellaneous

Technic

RADIOTHERAPY

RADIOISOTOPES

RADIATION EFFECTS

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

The Revolution Produced by Cerebral Angiography in Management of the Patient with "Stroke." Robert A. Kuhn. J. M. Soc. New Jersey **56:** 68–75, February 1959. (20 Madison Ave., Morristown, N. J.)

In a series of over 100 "strokes" of all kinds, the author has used cerebral angiography without morbidity or mortality. These studies have accentuated the frequent discrepancies between clinical and anatomic diagnoses in cases of "stroke" and have established unequivocally that a variety of lesions have the capacity to produce clinically similar states of cerebral neurologic dysfunction. The exact recognition of these lesions has become increasingly important with recent advances in medical and neurosurgical therapy. Cerebral arteriography has proved to be a safe and reliable technic to aid in the accurate diagnosis of both the common and uncommon types of brain dysfunction.

Occlusive cervical carotid artery disease, one of the most important causes of "stroke," can be distinguished from cerebral artery occlusion or insufficiency from other causes only by cerebral arteriography. This distinction is of particular significance, since surgical measures to restore a normal supply of arterial blood to the brain are increasingly successful. In cerebral artery occlusion angiography will demonstrate persistent failure of one or more vessels to fill, whereas in the presence of a slowly growing brain tumor or an intracranial arteriovenous anomaly characteristic alterations in the arterial pattern are observed. Accurate diagnosis can also be accomplished in patients with bleeding from various other causes.

Five cases are reported in which angiography permitted a diagnosis which the author considered definitive.

Circumstances Surrounding Complications of Cerebral Angiography. Analysis of 546 Consecutive Cerebral Angiograms. David R. Coddon and Howard P. Krieger. Am. J. Med. **25:** 580–589, October 1958. (Mt. Sinai Hospital, New York, N. Y.)

The circumstances surrounding 109 complications attending 546 consecutive cerebral angiographic examinations of 483 patients at the Mt. Sinai Hospital (New York) between July 1952 and December 1956 were reviewed. Two hundred and seventy-five of the patients were males and 208 females. The youngest patient was three years old, the oldest eighty-five; 52 per cent of the patients were over fifty years of age. Of the 546 examinations, 530 were performed by the percutaneous technic. In the remaining 16 cases the common carotid was exposed and cannulated, either because of failure to puncture the artery by the percutaneous method or because of contemplated ligation. Ten to 12 c.c. of 35 per cent Diodrast was used in all except 6 cases, in which 50 to 100 c.c. of 70 per cent Urokon was injected *via* the antecubital vein.

For the purposes of the present investigation, a complication is defined as any objective detrimental alteration in the patient's well-being within the first twenty-four hours following arteriography. Over 90 per cent of the 109 complications were manifest during or just after the procedure. The complications occurred in 86 patients (17 per cent), giving an overall complication rate of 22 per cent in relation to the total number of patients or 19 per cent of the total number of arteriograms.

Ninety-five of the complications were transient, lasting less than six hours; 44 of these were innocuous and 51 were serious. Six complications were permanent but nonfatal. There were 8 deaths, only one of which appeared to be directly related to arteriography. Forty-three complications consisted of progression of neurologic signs, including aphasia, hemiparesis, and stupor; convulsions, focal or general (6); cavernous sinus thrombosis (1); ipsilateral blindness (1); meningeal reaction (1); carotoid sheath hematoma (1); catatonic behavior (1); quadriplegia (1); nuchal hematomas, dysphagia, or sore throat (37); hemorrhage in fundi (3); allergic reaction (6); acute respiratory distress (12); syncope during cannulation of the artery (1); shock (7); retropharyngeal hematoma (1).

Analysis of the present series indicates two factors to be associated with the occurrence of serious complications: (1) depression of consciousness and (2) progression of neurologic signs. No relationship between the cardiovascular and hypertensive status of the patient and occurrence of a complication was demonstrable. One-fourth of the patients with aneurysms suffered a serious complication; no apparent cause for this high rate was found.

The value of arteriography must be considered in view of the incidence and severity of such complications. In the present series 80 per cent of the arteriograms gave diagnostically useful information. Therefore, in consideration of the low rate of significant morbidity and the low rate of mortality, it is the authors' opinion that in selected cases cerebral arteriography provides diagnostic information which outweighs the risk of complication.

Ten tables.

Electrocardiographic Alterations Observed During Percutaneous Cerebral Angiography. Iodopyracet (Diodrast) and Diatrizoate (Hypaque). Joseph A. Epstein, Irwin Hoffman, and Bernard S. Epstein. Arch. Neurol. & Psychiat. **81:** 142–147, February 1959. (Long Island Jewish Hospital, New Hyde Park, N. Y.)

Intracarotid Diodrast injections have been shown to produce a vascular necrobiotic change affecting particularly the arterioles, followed by ischemic necrosis of surrounding parenchyma. The intensity of injury varies with the time the contrast medium remains in contact with the involved tissues. It is interpreted as a chemotoxic effect on vascular endothelium, producing vasospasm with resulting edema, vascular engorgement, and punctate hemorrhages in the central portions of the damaged areas. Electrocardiographic changes described are bradycardia, loss of the P-wave, and ectopic beats. Such alterations have been considered to be the result of central nervous system changes or vagal stimulation and not due to a direct myocardial action.

The present paper is based on 80 carotid arteriographic studies in 35 patients, many of whom were suspected to have brain tumors or intracranial bleeding. Fifty per cent Hypaque and 35 and 40 per cent Diodrast solution were used. Serial electrocardiograms were taken before, during, and after the injections. Control injections of isotonic saline were made with electrocardiographic tracings for comparison.

No alterations followed injections of isotonic saline

and there was no difference in the responses to the two concentrations of Diodrast. No changes were observed in 30 per cent of the Hypaque injections and in 26 per cent of Diodrast injections. A slight slowing of heart rate occurred following 43 per cent of the Hypaque injections and in 26 per cent of Diodrast injections. But profound slowing of heart rate (a change in rate of 40 or more) occurred in only 7 per cent of the Hypaque group as compared with 26 per cent of the Diodrast group. This response was accompanied by sinus arrest for as long as ten seconds in one case. Sinus arrest was followed by ventricular escape with shift of the cardiac pacemaker to the coronary sinus or to the AV node, followed by the development of nodal rhythm and irregularities in pulse rate for periods of fifteen to thirty seconds. More severe effects were obtained with 35 and 40 per cent Diodrast solutions than with 50 per cent solutions of Hypaque.

The electrocardiographic responses could be explained only on the basis of vagal stimulation. Local infiltration of the area of the carotid sinus with procaine effectively eliminated vagal responses previously obtained, suggesting that the afferent impulses responsible for stimulation of vagal centers in the medulla had their origin in the chemically sensitive carotid body.

The morbidity associated with percutaneous cerebral angiography may be related to the cardiovascular effects of the compounds employed. The area of the carotid bifurcation should be anesthetized before the performance of angiography in those patients in whom a fall in blood pressure or change in cardiac rate or rhythm would be dangerous.

Four figures; 1 table. SHAWKI ASMAR, M.D.
Cleveland Metropolitan General Hospital

The V-Test. George Voluter. Radiol. clin. Suppl. to Vol. 28, 1959. (In English and French) (M. D. Anderson Hospital, Houston, Texas)

Anthropometric studies of more than 1,000 roentgenograms of the human cranium have led the author to propose that roentgenograms of the sella turcica be used as a means of identifying disfigured and mutilated victims of catastrophes. The cranial base, covered by the elastic brain tissue, itself enclosed as a ball inside the concave cranial bones, is efficiently protected against the worst injuries. Each individual has his specific sella turcica, its distinctive characteristics being (1) shape and volume; (2) the angle formed by the basilar plane and the plane of the anterior cranial fossa; (3) the morphological properties of the clinoid apophyses, the formation of bony ridges and osteophytes; (4) the characteristic bony structure and pneumatization of the sellar mass; (5) the size and shape of the sphenoidal sinus. The roentgen picture therefore furnishes complete anthropometric identification.

The plan is to identify a victim by comparing an *in vivo* roentgenogram of the cranial base with one made on the cadaver. This method of identification could be employed for all persons engaged in dangerous professions. A photoradiographic apparatus utilizing small films could be used at minimal expense. The establishment of radioanthropometric files is recommended for the army, navy, air force, and police, and for insurance companies, industries, etc.

In recognition of the author, whose name begins with the letter V, the procedure described has been designated the "V test."

Seven figures, including 2 roentgenograms.

Ocular Findings in Brain Tumors in Children. Ulysses M. Carbajal. Arch. Ophth. **61:** 599-607, April 1959. (635 S. Westlake Ave., Los Angeles 57, Calif.)

This paper is concerned with the ocular findings in 175 children with proved brain tumor, seen at the Los Angeles Childrens Hospital, and the role of the ophthalmologist, in conjunction with the pediatrician, radiologist, and neurologist, in diagnosis.

The most important ocular finding was papilledema (*i.e.*, passive noninflammatory edema of the disks, regardless of the intracranial pressure), which was present in 127 cases. Other common findings were: visual field defects (in 26 of the 52 cases in which the field were plotted); nystagmus (58 cases); ocular motor palsies (40 cases); pupillary changes (30 cases); failing vision (19 cases); optic atrophy (19 cases). Less frequent were ptosis (5 cases); corneal anesthesia (5 cases); lagophthalmos (2 cases); Horner's syndrome and lid lag, 1 each. Twenty-seven of the 39 patients with papilledema undergoing spinal tap were found to have some elevation in the spinal fluid pressure. The most reliable sign of increased intracranial pressure was enlargement of the ventricles. The course of the papilledema varied with the rapidity of the growth of the tumor as well as its location. Papilledema of acute onset is associated with retinal hemorrhage; chronic papilledema tends to be followed essentially by optic nerve atrophy, depending on the degree of the nerve-head swelling.

The brain tumors in this series are grouped after Cushing's classification, and the incidence of papilledema in each group is tabulated. There were 130 gliomas and 15 craniopharyngiomas. Of the gliomas, 77 per cent were associated with papilledema in contrast to 46 per cent of the craniopharyngiomas.

In 125 patients, x-ray reports were available. Findings were as follows:

Widening of cranial sutures	87
Enlargement of 1 or more ventricles	64
Calcification or erosion in or over the sella turcica	22
Increased convolutional markings	8
Calcified tumors	4
Herniation of cerebellar tonsils	2
Enlargement of optic foramen	1
Craniostenosis	1

Separation of the cranial sutures was noted in 87 of 92 patients with papilledema; on the other hand, it was noted in 11 of 27 patients without papilledema. This indicates either (*a*) that the papilledema might not have appeared by the time these patients were seen or (*b*) that the widening of the sutures might have prevented the development of significant papilledema. The above figures bear out the fact that, during childhood, papilledema and separation of cranial sutures go hand in hand, with no significant disparity except in the first year of life. It is conceivable that, since the cranial sutures are quite stretchable at this stage of development, their separation can easily take place and even delay the onset of papilledema. At puberty and later, the cranial sutures become more firm; hence, the incidence of the papilledema then outshadows that of suture separation.

Of 64 ventriculograms, only 11 were negative. The

lateral and third ventricles were most commonly involved, the site of obstruction being at the aqueduct of Sylvius. Ten of 12 patients without papilledema who had ventriculographic studies showed some dilatation of the ventricles. If papilledema was truly absent in these 10 cases, one might conjecture that enlargement of the ventricle was quite gradual or that there may have been some anatomic variation, such as a narrow optic foramen, a small intervaginal space around the optic nerve, or some rigidity of the lamina cribrosa.

The author concludes that the role of the ophthalmologist in the diagnosis of brain tumors is twofold: first, he acts as a consultant concerning eye findings; second, he acts as an ordinary practitioner referring cases to the neurological specialist.

One graph; 15 tables.

Myelographic Syndrome of Caudad Dislocation of the Brain Stem. Changes in the Position, Mobility and Form of the Upper Cervical Spinal Cord in Cases of Intracranial Expanding Lesions. Jan Jirout. Brit. J. Radiol. **32:** 188–192, March 1959. (Charles University, Prague, Czechoslovakia).

In a review of 400 pneumoencephalograms the author found that certain cases of intracranial expanding lesion bring about a change in the position, mobility, and form of the upper cervical spinal cord. The majority of such lesions were situated in the anterior part of the supratentorial space, *i.e.*, in a position from which an axial pressure cone could be expected in the anteroposterior direction. The signs of caudal dislocation, present in 26 instances, were as follows:

1. Backward shift of the upper spinal cord. 2. Backward arch-like bending of the upper cervical spinal cord with concave anterior surface. 3. Widening of the anterior subarachnoid space for two or three upper cervical segments. 4. Loss of physiologic mobility with positional change of the body.

The axial dislocation is best visualized in the lateral supine view of the antiflexed cervical spine.

Eight roentgenograms. P. F. CHRISTENSON, M.D.
Fontana, Calif.

Roentgenographic Findings in Trigeminal Neuralgia. J. Bjerrum and G. Thornval. Acta radiol. **51:** 289–296, April 1959. (Bispebjerg Hospital, Copenhagen, Denmark)

Among the theories that have been proposed for the pathogenesis of trigeminal neuralgia is traction of the nerve as it courses through the skull. Gardner and his associates in 1956 published a roentgenographic study supporting this view (Am. J. Roentgenol. **76:** 346, 1956. Abst. in Radiology **68:** 885, 1957). In a number of postero-anterior films of the skulls of patients with trigeminal neuralgia they were able to measure the distance from the trigeminal impression to a horizontal line touching the roof of the orbit. This showed the trigeminal impression to be at a higher level on the side of the trigeminal pain. Furthermore, they determined the relationship of the tip of the odontoid process to McGregor's line and found a larger basilar impression in patients with trigeminal neuralgia than in a corresponding normal series.

In order to test the findings of Gardner *et al.* the authors made similar measurements in 54 cases of trigeminal neuralgia plus 100 control cases. The petrous apex was definitely elevated on the side of symptoms in the majority of cases. Of 8 cases of bilateral neuralgia, 5 had equally elevated trigeminal impressions. The control group showed no significant variations. Studies of lateral skull films to determine the degree of basilar impression as measured against McGregor's line revealed no conclusive evidence of increased basilar impression in neuralgic patients.

The authors conclude that the elevated petrous bone is an anatomic variant. With advancing age the brain is displaced caudally, with traction on the trigeminal nerve. Such traction is more marked in the presence of elevation of the petrous apex, and this may represent the actual etiology of trigeminal neuralgia.

Three roentgenograms; 4 diagrams; 3 tables.

CAPT. ALLAN E. GREEN, M.C.
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The Role of the Cricopharyngeal Muscle in Cases of Hypopharyngeal Diverticula. A Cineroentgenographic Study. Gösta Dohlman and Ove Mattsson. Am. J. Roentgenol. **81:** 561–569, April 1959. (Institute of Laryngology and Otology, London, W. C. 1, England)

The authors describe the role of the cricopharyngeus in swallowing and discuss the pathophysiology leading to hypopharyngeal diverticula. In normal swallowing, the larynx moves upward and forward. The cricopharyngeus muscle is stretched, since its anterior sector is attached to the cricoid cartilage, while the posterior sector is part of the posterior pharyngeal wall and cannot be torn away from the surface of the prevertebral muscles. The authors surmise that stretch receptors in the muscle bundles of the cricopharyngeus take part in the initiation of the reflex which results in a relaxation of the cricopharyngeus.

In elderly persons, with a certain flaccidity in their tissues, loose tissue from the mediastinum or paravertebral spaces may be mobilized into the prevertebral space during swallowing. In this event, the posterior hypopharyngeal wall, being less firmly attached to the prevertebral layer than normally, moves forward with the larynx during the swallowing act. The cricopharyngeal muscles will not be stretched and the normal reflex necessary for relaxation of the cricopharyngeus is not initiated. Such a failure in the opening reflex of the cricopharyngeus may cause difficulties in swallowing along with a feeling of obstruction.

The presence of a weak triangle in the posterior pharyngeal wall just above the circular fibers of the cricopharyngeal muscle is considered a factor of importance for the development of a diverticulum. Under normal conditions this portion of the wall is supported by the prevertebral muscle layer; however, if a layer of loose connective tissue were present behind the pharyngeal wall, this support would be lacking. Due to the increased hypopharyngeal pressure secondary to a failure of relaxation of the cricopharyngeus and the lack of normal support of the prevertebral muscle layer to the posterior pharyngeal wall, a diverticulum could result.

Three roentgenograms; 4 cineroentgenographic series. EUGENE C. KLATTE, M.D.
Indiana University Medical Center

Carotid Body Tumours, with Case Presentation and Angiographic Demonstration. J. A. Myburgh and M. E. Berk. South African M. J. **33:** 329–333, April 18, 1959. (Johannesburg General Hospital, Johannesburg, Union of South Africa)

The paper is a general review of the subject of

carotid body tumors and includes information on anatomy, physiology, and pathology of the carotid body and its neoplasms. The typical tumor presents as a symptomless, slowly growing lump in the upper anterior portion of the neck. An important physical sign is the demonstration of the external carotid artery coursing over the anterolateral aspect of the tumor. Although biopsy will confirm the diagnosis, the point is stressed that criteria for differentiation of benign and malignant lesions are difficult to obtain. Various reviews indicate that approximately 15 per cent of these tumors are malignant and may show distant blood-borne metastases.

The authors feel that carotid angiography may be very helpful in diagnosis. They inject percutaneously 10 c.c. of 60 per cent Urografin, and obtain films in anteroposterior and lateral projections. The first exposure is made soon after the injection is begun, because of the proximity of the tumor to the injection site. The second film is made four to six seconds later in order to demonstrate "tumor stain" or "blush." Characteristic findings include splaying of the carotid bifurcation with lateral displacement of the internal carotid and medial displacement of the external carotid. Carotid body tumors are ordinarily very vascular and will demonstrate clearcut pooling of the contrast material in their vascular network.

As a general rule, adequate treatment consists in complete surgical excision. The tumor must be dissected free from the important arterial structures and the arteries maintained intact. Triple ligation of the common carotid and its two major branches carries too high a mortality rate to be considered a desirable means of treatment.

A case is reported occurring in a 57-year old man with typical clinical and physical findings. The arteriogram showed the above-described characteristic features. The patient refused surgery.

Five roentgenograms showing the characteristic arteriographic findings.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Tomography in The Diagnosis of Meningiomas of the Alae of the Basilar Bone. Ya. I. Geinisman. Vestnik Rentgen. i. Radiol. **34:** 3–8, March–April 1959.

Thirty-five cases of meningioma of the sphenoidal wings were studied. Tomographic cuts taken in frontal, lateral, and oblique views have proved superior to plain roentgenograms, permitting precise localization. Both wings are usually involved, only 1 of the cases being limited to the lesser wing. It was also found that hyperostosis of the alae will cause unilateral exophthalmos.

B. ABRAMSON, M.D., AND F. RIEBEL, M.D.
Columbus, Ohio

THE CHEST

The Natural History of Carcinoma of the Lung. George L. Emerson, Marion S. Emerson, and Charles E. Sherwood. J. Thoracic Surg. **37:** 291–304, March 1959. (University of Rochester School of Medicine and Dentistry, Rochester, N. Y.)

Three hundred and sixty cases of proved bronchogenic carcinoma have been reviewed, with particular reference to the appearance of such lesions on any past roentgenograms before definitive diagnosis.

Forty-seven of the patients were females and 313 males. The average age of all patients was 58.9 years. The cell type in the 360 cases was epidermoid, 146 cases; undifferentiated epidermoid, 143 cases; adenocarcinoma, 33 cases; oat-cell, 17 cases; not classified, 9; no section (gross appearance), 12 cases. The average interval between first clinical symptoms and clinical diagnosis in 359 cases (no recorded clinical history in 1 case) was 6.8 months (extremes of 0 to sixty months); the average interval between first symptoms and pathologic diagnosis was 7.8 months (extremes 0 to sixty months). The average interval between the earliest roentgen evidence of lung cancer and the clinical diagnosis in 350 cases (no available roentgenograms for review in 10 cases) was four months.

In reviewing the earlier roentgenograms, changes were sought which could be correlated with the eventual, more gross evidence of the neoplasm. The types of change seen and their frequency are recorded in the accompanying table.

The data relating to the early roentgenographic findings in cancer of the lung emphasize that certain changes are highly significant. Hilar, mediastinal and large parenchymal masses, as well as gross atelectasis, produce roentgen shadows strongly suggestive of carcinoma

TYPES OF EARLY RADIOGRAPHIC ABNORMALITIES FOUND IN 350* CASES PROVED TO BE LUNG CANCER
(Emerson *et al.*: Natural History of Carcinoma of the Lung)

Radiographic Finding	Total	Found Alone	With 1 Other Abnormality	With 2 Other Abnormalities
Obstructive pneumonitis	129 (36.8%)	60 (16.7%)	56 (15.5%)	13 (3.6%)
Parenchymal mass	77 (21.4%)	45 (12.5%)	24 (6.7%)	8 (2.2%)
Over 1 cm. in size	67 (18.6%)	35 (9.7%)	24 (6.7%)	8 (2.2%)
1 cm. or less in size	10 (2.8%)	10 (2.8%)	0	0
Hilar nodularity	72 (20.0%)	17 (4.7%)	47 (13.1%)	8 (2.2%)
Hilar mass	69 (19.4%)	35 (9.7%)	25 (6.9%)	9 (2.5%)
Atelectasis	53 (14.8%)	27 (7.5%)	26 (7.2%)	0
Mediastinal nodes or mass	32 (8.9%)	6 (1.7%)	19 (5.3%)	9 (2.5%)
Pleural effusion	30 (8.3%)	4 (1.1%)	20 (5.6%)	7 (1.9%)
Parenchymal fibrous infiltrate	11 (3.1%)	9 (2.5%)	2 (0.6%)	0
Perihilar infiltrate	10 (2.8%)	8 (2.2%)	2 (0.6%)	0
Parenchymal mass with breakdown	8 (2.2%)	6 (1.7%)	2 (0.6%)	0
Obstructive emphysema	7 (1.9%)	1 (0.3%)	6 (1.7%)	0
Lung infection with abscess	5 (1.4%)	3 (0.8%)	2 (0.6%)	0
Diffuse parenchymal tumor	2 (0.6%)	1 (0.3%)	1 (0.3%)	0

* Ten cases of total series had no available roentgenograms for review.

and are of serious import. Somewhat less obviously produced by a cancer, but to be viewed with a high degree of suspicion, are obstructive pneumonitis, the small hilar nodule, localized emphysema, and thick-walled irregular abscesses. These carry a slightly less grave outlook, when diagnosed without delay.

The authors believe that the isolated parenchymal nodule should be regarded as malignant until proved otherwise. The smaller the nodule, the less apt it is to have associated roentgen changes and the better is its prognosis. The small persistent infiltrative density should be viewed with almost equal suspicion. It will most frequently be confused with a residual fibrous change from inflammatory disease, and the distinction, on pure roentgenographic grounds, is often impossible with a single film.

A definite factor in late diagnosis of carcinoma of the lung is the abnormal roentgenogram which is read as normal. This will happen with even the most experienced eye and will not be completely eliminated. All efforts, however, should be directed toward keeping this factor to a minimum. The ideal would be double reading of roentgenograms, particularly the normal ones. A minimal change in the hilar shadow is frequently overlooked on a single film where it would be more obvious on comparison with a previous normal film. Consequently, all available past roentgenograms should be assembled for combined study by clinician and radiologist. The destruction of chest films should be discouraged.

Some 44 per cent of the patients in the present series had no chest roentgenogram taken prior to the time of diagnosis, or none was available. Yet the changes present on admission films were such as to indicate that, in many instances, if films had been taken during the preceding year these would have been positive. An increase in mass surveys in people over forty years of age should be supported, and patients should be encouraged to obtain periodic x-ray studies of the chest along with physical examinations.

Eighteen roentgenograms; 11 tables.

Survival in Lung Cancer. Katharine R. Boucot, Utako Horie, and Martin J. Sokoloff. New England J. Med. **260:** 742–746, April 9, 1959. (Woman's Medical College of Pennsylvania, Philadelphia, Penna.)

Two hundred and fifty cases of primary lung cancer surveyed between February 1947 and December 1956 were followed through March 1957. No case was lost to follow-up study.

An attempt was made to classify the types of abnormality appearing on the first abnormal chest films and to correlate these with survival rates. Five-year survival rates were used when numbers were adequate; three-year rates in other cases. The overall five-year survival rate, calculated from the date of the first abnormal film, was 17 per cent; one man lived for nine years without surgery. For patients over fifty-five the survival rate was 20 per cent; under that age, 12 per cent. Squamous-cell carcinoma seemed to offer a better prognosis than adenocarcinoma or undifferentiated carcinoma.

A rather elaborate classification was set up, but the only important correlation with prognosis was between tumors arising as solitary nodules and all other tumors. Of the 250 cases in this series, 28 (11 per cent) originated as solitary nodules. Only 18, a number too small for statistical significance, were in the study long enough for determination of three-year survival rate. This was 56 per cent as compared to 21 per cent for those with lesions other than solitary nodules.

Since cases seemed to do better, with longer survival, if discovered early, semiannual studies of the chest of asymptomatic older persons, and overreading of abnormalities thus discovered are recommended.

Two roentgenograms; 2 charts; 4 tables.

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Primary Alveolar Carcinomatosis (Carcinoma) of the Lung (So-Called Pulmonary Adenomatosis or Alveolar-Cell Tumour). A Review and Report of 12 Cases. E. Roelsen, Tage Lund, Tyge Søndergaard, Bent Møller, and A. Myschetzky. Acta med. scandinav. **163:** 367–384, 1959. (Central Hospital, Silkeborg, Denmark)

Twelve cases of primary alveolar carcinomatosis (so-called pulmonary adenomatosis or alveolar-cell tumor), encountered during an eight-year period in a relatively small district in Denmark, are reported. The incidence of this form of lung cancer during the years 1949–1956 was calculated to be 3.5 per cent of that of all lung cancers from the Danish district concerned (population *c.* 500,000).

Seven of the authors' patients were women and 5 were men, with an age range from thirty-seven to seventy-eight. In large part the cases fulfilled the criteria set up by Storey *et al.* (J. Thoracic Surg. **26:** 331, 1953. Abst. in Radiology **63:** 279, 1954). Eight of the cases were typical of the multiple or diffuse form of primary alveolar carcinomatosis of the lung and 4 were of the solitary form (carcinoma). The clinical picture in the two forms differed widely. Dyspnea and cyanosis were predominant in the diffuse variety but scarcely present in the solitary form; with a few exceptions, a productive cough was common to both. Clinically, the radiographic appearance constitutes the most important criterion of the disease. In the diffuse form the findings varied widely, rendering differential diagnosis extremely difficult. Changes may be suggestive of sarcoidosis. They are often predominant in the hilar regions. On some occasions, they may give the impression of dissemination of tubercles or infiltrates of an undeterminable nature, resembling bronchopneumonia, pneumoconiosis, or even bronchiectasis. The roentgen picture in the solitary form is less complex, a solitary infiltration or round shadow, but also noncharacteristic.

Only 1 of the patients with the diffuse form of pulmonary alveolar carcinomatosis raised abundant amounts of sputum. Cytologic examination of sputum, carried out in 8 cases, revealed tumor cells in 5. Bronchoscopy was performed in 3 of the 4 solitary cases, with positive findings in 2. The erythrocyte sedimentation rate was elevated in only 7 of the 12 cases.

The diagnosis was established in the 8 diffuse cases by autopsy. In the 4 solitary carcinomas, it was confirmed by histologic examination of specimens removed at surgery. The authors emphasize that the macroscopic changes, on section, were reminiscent of gray hepatization of lobar pneumonia. Histologically, the alveolar structure was preserved, the walls of the alveoli being lined with cancer cells with varying degrees of differentiation. Invasive growth into the lymphatics was common, and metastatic lesions were found in half of the cases. In 7 instances, in addition to the alveolar changes, there were changes in the epithelium of the

bronchioles. It is thought likely that this special form of cancer may arise both from the alveolar epithelium and from the bronchioles and that it may be of either multicentric or unicentric origin.

All of the 8 patients with the diffuse form of carcinomatosis died within nine months of the onset of symptoms. The 4 patients with solitary lesions were treated surgically; 2 were alive, five years and sixteen months, respectively, after operation.

Four roentgenograms; 4 photomicrographs.

Sarcoidosis. An Analysis of Forty-Five Cases in a Large Military Hospital. Ellis P. Singer, Nestor M. Hensler, and Paul F. Flynn. Am. J. Med. **26:** 364–375, March 1959. (E. P. S., Plainfield, N. J.)

Forty-five cases of sarcoidosis seen at the Pulmonary Disease Center of the Parks Air Force Base Hospital (California) between 1953 through 1957 are reviewed. Four of the patients were women. Of the 41 men, 25 were Negroes. Thirty-six of the male patients were below the age of thirty.

Eighteen of the patients visited a physician because of symptoms, but in 22 cases a roentgenogram of the chest, taken in connection with a routine physical examination or because of symptoms not related to sarcoidosis, demonstrated disease. On careful questioning, however, only 9 of the 45 patients were entirely asymptomatic. Respiratory complaints predominated, cough being the most frequent. Blurred vision of rather sudden onset was the most common ocular complaint. The most prominent physical finding was lymphadenopathy, occurring in 25 patients. Slit-lamp examination disclosed evidence of uveitis in 11 of 22 patients so examined. Other less common physical findings were hepatomegaly in 4; skin nodules in 2 (erythema nodosum in 1); thickened epididymis in 2; widened superior mediastinum in 2; and nasal mucous membrane thickening in 1 case. Thirty-four of 43 patients showed a hyporeactivity to tuberculin skin test. Sensitivity to other antigens was also observed to be depressed. Abnormal laboratory findings included hyperglobulinemia, hypercalcemia and, not infrequently, leukopenia, with relative lymphocytosis and eosinophilia.

All 45 patients in the present series had one or more chest roentgenograms, and in only 1 were the findings within normal limits. Bilateral hilar adenopathy with parenchymal involvement was the most common finding (23 cases). Adenopathy alone occurred in 16 cases, parenchymal changes alone in 5. The roentgen changes associated with sarcoidosis involving the pulmonary parenchyma have been classified into four types: (1) diffuse and confluent infiltration; (2) linear type of infiltration usually extending fanwise from the hilus; (3) disseminated miliary lesions; and (4) a coarse nodular infiltration. Adenopathy alone, either hilar or paratracheal, or both, was slightly less frequent. Evidence of pleural disease, either past or present, was seen in 5 patients: blunted costophrenic angle in 2, thickened horizontal fissure in 2, and equivocal evidence of free fluid in 1 patient on a lateral decubitus view. In contrast to the high incidence of bone changes in other series, only 1 of the authors' patients showed changes in roentgenograms of hand and/or foot, and these were minimal; this may be a reflection of early recognition of the disease or of the early age of the patients studied.

Thirty-five of the 45 patients received no definite treatment. Twelve patients received corticosteroid therapy; 7 showed improvement; in 3 the condition remained unchanged; and in 2 it worsened. The authors believe that topical use of steroids should be the initial treatment for all those whose main or sole disability is uveitis.

Four of the more interesting cases are reported in detail.

Four roentgenograms; 3 photomicrographs; 5 tables.

Bronchopulmonary Sarcoidosis. Some Unusual Manifestations and the Serious Complications Thereof. Frank J. Talbot, Sol Katz, and Mary Jane Matthews. Am. J. Med. **26:** 340–355, March 1959. (F. J. T., District of Columbia General Hospital, Washington 3, D. C.)

Eight cases are reported to illustrate some of the unusual manifestations and complications of bronchopulmonary sarcoidosis: (1) sarcoidosis simulating metastatic lung disease; (2) sarcoidosis producing middle lobe syndrome; (3) honeycomb lung due to diffuse sarcoidosis of lung parenchyma with recurrent spontaneous tension pneumothorax; (4) severe hemoptysis secondary to bronchial changes of sarcoidosis; (5) mediastinal sarcoidosis presenting with dysphagia and Horner's syndrome; (6) sarcoidosis of the larynx; (7) diffuse miliary pulmonary sarcoidosis simulating miliary tuberculosis; (8) migratory pneumonitis due to sarcoidosis. Roentgenograms are reproduced for each case.

The diagnosis of sarcoidosis is based on a correlation of clinical, radiologic, immunologic and laboratory data supported by histologic evidence of epithelioid tubercles with little or no evidence of caseation. The key to diagnosis is widespread organ involvement with few or mild constitutional manifestations. The diverse clinical types are due to the association of lesions in many organs in various combinations. There are few diseases with the protean patterns of sarcoidosis.

There are few findings which appear to have some specific connotation for or against a diagnosis of sarcoidosis. The presence of granulomas in the parietal pleura speaks for tuberculosis; the presence of similar lesions in skeletal muscles and salivary glands is compatible with sarcoidosis. Aside from these rules of thumb, the pathologist is best able to assist the clinician by identifying the granulomas, performing special stains to rule out acid-fast and mycotic infections, and culturing material, if adequate amounts are available. When both clinical and pathologic efforts to identify an offending agent are fruitless, a clinical impression of sarcoidosis is justifiable.

Seventeen roentgenograms.

Nonobstructive Consolidation-Atelectasis Following Thoracotomy. Morris M. Culiner, Stanley B. Reich, and Jacob Abouav. J. Thoracic Surg. **37:** 371–381, March 1959. (Mount Zion Hospital, San Francisco 15, Calif.)

Four cases of lung consolidation-atelectasis following thoracotomy are reported. This complication results from phrenic paralysis in association with restriction by pain of the respiratory excursions of the thoracic wall, despite a clear tracheobronchial tree.

The diagnosis of nonobstructive consolidation-atelectasis was established on radiologic and clinical evidence.

1. All cases showed opacification of the hemithorax. The collapse did not occur immediately after thoracot-

omy, but rather over a period of several days postoperatively. This suggests a slow process resulting from weakness of chest wall excursions with gradual collapse, as opposed to the rapid atelectasis secondary to bronchial occlusion.

2. Mediastinal shift was to the side of collapse. When spontaneous aeration took place, there was a return of the mediastinum to a more normal midline position in all cases.

3. All patients exhibited paralysis of a diaphragmatic leaf. This was temporary in 2 cases and permanent in 2.

4. The patency of the major tracheobronchial tree was established by bronchoscopy in all cases during the period of collapse, at a time when maximum opacification was demonstrated roentgenologically.

Bronchoscopy was performed on one or two occasions in each case; in addition, auscultation of the chest one or more times each day ruled out obstruction by secretions as the basis of the pulmonary collapse. Also, the roentgenogram in 2 of the 4 cases showed relatively clear patent major bronchial and segmental bronchial subdivisions in otherwise opaque collapsed pulmonary tissue. In the authors' cases, no improvement followed bronchoscopy and removal of the minimal secretions present in the tracheobronchial tree.

It is concluded that these cases represent consolidation-atelectasis of a nonobstructive nature, due rather to paralysis of the ipsilateral muscles of respiration, diaphragmatic and intercostal. The phrenic paralysis was confirmed in all cases and was permanent in 2, and inhibition by pain of the intercostal muscle action was marked in all but 1 patient, an infant.

Treatment must be directed to counterbalancing the factors responsible for the lung collapse. The phrenic paralysis cannot be altered. The voluntary ventilatory restrictions can be reduced by intercostal nerve blocks, by respiratory exercises, and by the use of an intermittent positive pressure machine. When, in the postoperative period, there is a failure of the ipsilateral lung to become, or to remain, expanded, and obstruction is not present, one might ordinarily consider re-exploration on the assumption that the residual lung collapse resulted from torsion of the pulmonary pedicle or vascular thrombosis. This, however, should not be done until the syndrome of nonobstructive consolidation-atelectasis has been ruled out by bronchoscopy, fluoroscopic study of diaphragmatic action, and observation of the degree of respiratory excursion of the ipsilateral thoracic wall.

Twenty roentgenograms.

Solitary Pulmonary Nodules Found in a Community-Wide Chest Roentgenographic Survey. A Five-Year Follow-up Study. Sabine M. Holin, Ralph E. Dwork, Stanley Glaser, Arthur E. Rikli, and Joseph B. Stocklen. Am. Rev. Tuberc. **79:** 427–439, April 1959. (Outpatient Department, Sunny Acres Hospital, Cleveland, Ohio)

The authors selected all persons with solitary pulmonary nodules found in 1949 among over 600,000 persons in Cuyahoga County, Ohio, which includes the city of Cleveland. The survey covered nearly 65 per cent of the adult population. A total of 666 persons were found with a solitary nodule in the lung parenchyma which was roughly spherical or lobulated and fairly well circumscribed. Only nodules of 10 mm. or more in diameter and not obviously adherent to adjacent structures were included, and any such lesions which contained calcium were discarded. Only 3 per cent were proved to be malignant over a five-year interval, while 9 per cent were diagnosed as tuberculous. This percentage is much smaller than that reported in most published studies. Of the group, 80.5 per cent were alive and had no symptoms attributable to the nodule during the five-year study. Only 2.6 per cent had died of causes related to the nodule, and all of these deaths were attributed to pulmonary cancer. The etiology had been established for only 13.8 per cent of the study group, but the authors feel that all of the neoplasms had most likely become evident during the five-year interval.

It is concluded that the factors used in selecting a study group are of major importance in determining the proportion of cancer. For example, while the incidence was 3 per cent in this study, it was 35 per cent if only males over forty-five were included, with poorly circumscribed lesions showing no calcification and measuring 40 mm. or more in diameter. The size of the nodule was of definite importance, with a cancer incidence of 23 per cent for nodules 40 mm. or more in diameter. Decision for surgical removal of solitary pulmonary nodules must therefore be individualized.

Three figures; 6 tables. JOHN H. JUHL, M.D.
University of Wisconsin

Fluoroscopic Pulmonary Densiography. Albert H. Andrews, Jr., Robert Jensik, and William H. Pfisterer. Dis. of Chest **35:** 117–126, February 1959. (Presbyterian-St. Luke's Hospital, Chicago, Ill.)

Fluoroscopic densiography is a method of pulmonary function study in which the x-ray beam, after passage through the chest, is transformed into electrical energy, modified, and recorded on a strip chart. Fluoroscopic density is expressed as a percentage of the x-ray absorption. Respiratory fluctuation in an area is expressed as a percentage of the radiation transmitted by the chest in that area.

Fluoroscopic densiography is related only to ventilation and, unlike bronchospirometry, gives no indication of lung function in terms of oxygen consumption. Its advantage over bronchospirometry or bronchial catheterization lies in its requiring neither local anesthesia, premedication, nor introduction of tubes, which produce a degree of obstruction to air flow and possible alteration of respiratory reflexes. Radiation exposure is controlled by minimal duration of the examination and low x-ray factors, although the exposures actually are less than with most fluoroscopic examinations of the stomach.

While 50 people were examined during this study, the report is based upon the last 22 examinations conducted during a time when no major modifications in technic were made. The results in normal subjects were similar to those obtained by bronchospirometry. Two patients with unilateral radiation fibrosis had marked reduction in ventilation on the involved side. Patients with tumors showed increased density and decreased respiratory fluctuations. One with bilateral pulmonary cysts and blebs exhibited progressive inflation in the area of a large cyst, which suggested positive intracystic pressure. This was proved at thoracotomy. Respiratory fluctuations in diffuse obstructive pulmonary emphysema were variable, and no distinct pattern was identified.

Eight figures, including 2 roentgenograms; 3 tables.

A Preliminary Report on the Radiologic Evaluation of Trypsin in Certain Chronic Chest Diseases. Nathan E. Silbert. Dis. of Chest **35:** 162–169, February 1959. (Lynn, Mass.)

In a previous study (Silbert: Dis. of Chest **29:** 520, 1956) clinical changes were noted following the administration of trypsin to patients with certain chronic chest diseases. Daily intramuscular injections of the enzyme appeared to lessen the viscosity and tenacity of the sputum, facilitating its "raising." Subsequently the volume of the expectorate decreased and breathing became easier.

Radiologic examinations were made on all patients before and after a course of trypsin treatment. Some measure of difference was seen in almost all the patients and in half of them the degree of improvement was classed as marked. Roentgenograms of 6 cases, in which improvement was reported, were submitted to an impartial reviewing radiologist, who could see no x-ray evidence of improvement in 3, although such evidence was considered "quite definite, reliable and convincing" in the others. A brief clinical history of each of these last 3 cases (all with asthma of many years duration) is given, together with both the consulting and the reviewing radiologist's report.

In consideration of the subjective and objective findings, further studies are being carried on with particular reference to emphysema and bronchiectasis.

Nine roentgenograms.

A Case of Tracheomegaly. M. Rouan. J. franç. de méd. et chir. thorac. **13:** 417–422, 1959. (In French) (Dakar, French West Africa)

The author discovered, in a 22-year-old Senegalese, a congenital anomaly of the trachea and of the large bronchi, which had not previously been described. For this he proposes the name megatrachea or tracheomegaly. A plain chest roentgenogram and two tracheobronchograms show the dilated trachea (average diameter, 5 to 6 cm.).

Endoscopic and histopathologic studies follow the roentgenographic description.

Three roentgenograms; 2 endoscopic views.

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New York, N. Y.

Chronic Fibrous Mediastinitis and Superior Vena Caval Obstruction Due to Histoplasmosis. John M. Salyer, Harold N. Harrison, Dean F. Winn, Jr., and Richard R. Taylor. Dis. of Chest **35:** 364–377, April 1959. (Fitzsimons Army Hospital, Denver, Colo.)

Four patients, aged twenty-five to thirty years, were seen with bronchial or mediastinal venous obstruction due to chronic fibrous mediastinitis. In 2 of the cases organisms highly suggestive of *Histoplasma capsulatum* were identified. Multiple biopsies in the other 2 showed a histologic pattern suggestive of fibrosing mediastinitis due to histoplasmosis, though typical organisms were not isolated.

Many of the cases of "idiopathic" fibrosing mediastinitis seen today appear to be secondary to *Histoplasma capsulatum* infection. It is unlikely that tuberculosis was ever a significant cause of fibrous mediastinitis and vena caval obstruction and, with the present-day use of antibiotics, cases due to syphilis and the pyogenic infections have declined.

The salient pathologic feature of histoplasmosis appears to be a progressive evolution of remarkably dense sclerotic fibrous tissue with a tendency to invade all structures without respect for anatomical planes. The best chance for isolating the organism is within a caseous lymph node prior to its complete replacement by dense collagenous tissue.

The findings on the chest roentgenograms on the authors' 4 patients were varied and nonspecific. One case presented with a segmental infiltrate involving the anterior segment of the left upper lobe and showed slight upper mediastinal widening on later films. In another a 3-cm. right upper mediastinal mass was demonstrated, and still another showed only enlargement of the right hilus. In the fourth there was a right pleural effusion.

Sixteen figures, including 7 roentgenograms; 3 tables.

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THE HEART AND BLOOD VESSELS

Comparison of Three Methods of Screening for Pediatric Heart Disease. William Morton, Murray S. Hoffman, Roy L. Cleere, and Horace J. Dodge. J.A.M.A. **169:** 1169–1172, March 14, 1959. (W. M., 222 39th Ave., San Mateo, Calif.)

Each of three screening methods for heart disease was applied to 5,654 grade school children over a two-year period in two western Colorado communities. Each child was examined by miniature chest roentgenography, single lead electrocardiography (V_5R), and limited physical examination (inspection, palpation, and auscultation of the neck, chest, and radial and femoral arterial pulses). For each method an attempt is made to evaluate sensitivity and specificity, and a numerical value called the "efficiency index" is computed. As might be expected, the limited physical examination [as described it does not appear so limited—J.W.B.] proved to be the most specific and most sensitive index and gave the highest efficiency. The single electrocardiographic lead indicated heart disease in 58 of 5,600 students but additional studies showed that only 14 had truly abnormal hearts.

The single postero-anterior chest film (minifilm) taken alone was found not to be a sensitive tool for detection of heart disease in children. This is due at least in part to the difficulty of obtaining films at full inspiration in young children and the fact that most children with heart disease are in the early stages, when gross aberrations of cardiac size or shape are not to be expected.

The conclusion is that no screening procedure is infallible in finding heart disease. If only one is used, there a high risk of missing the diagnosis, particularly if physical examination is not the method employed.

Statistical data are presented in four short tables.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Criteria for Mitral Valvotomy: Roentgen Evidence in Pulmonary Hypertension. Richard S. Cosby and George Jacobson. California Med. **90:** 217–219, March 1959. (University of Southern California School of Medicine, Los Angeles, Calif.)

This paper is largely a review of work done by others in evaluating mitral stenosis. Patients with classical mitral diastolic murmur may be considered to be in three groups: (1) In cases of mitral stenosis with normal

pulmonary vascular pressure and insignificant degrees of mitral "block," valvotomy is useless. (2) In those with mitral stenosis complicated by active carditis, with reduction of cardiac output and only a slight increase in pulmonary vascular pressure, operation is contraindicated. (3) In the third group, those with true mitral block and varying degrees of pulmonary hypertension, operation is desirable.

Although catheterization is the most accurate and sometimes the only adequate means of measuring pulmonary hypertension as an indication for mitral valvotomy in rheumatic heart disease, it is so costly and complex that simpler methods are desirable. Clinical evidence of pulmonary hypertension is unreliable; electrocardiography is confirmatory in half of all cases. Roentgenologic findings are more helpful. Moderate or severe enlargement of the pulmonary arteries has been associated in 92 per cent of all cases with resting systolic pressures of 50 to 90 mm. of mercury in the artery (Jacobson *et al.* Radiology **68:** 15, January 1957). In cases where there is little or no enlargement, however, hypertension may still be present and demonstrable only by catheterization. Other roentgen signs noted as helpful are abrupt narrowing of the large branches of the pulmonary artery in the middle and lower lobes and the septal lines of Kerley.

Pulmonary hemosiderosis does not appear to have any specific correlation with mitral block and is found with all degrees of pulmonary artery pressure.

Six roentgenograms.

Retrograde Aortography in Acute Dissecting Aneurysm of the Aorta. C. R. Savage. Lancet **1:** 281-282, Feb. 7, 1959. (Warwick Hospital, Warwick, England)

A case of acute aortic dissection with obstruction of the right iliac artery is reported to illustrate the value of retrograde aortography in this condition and to show how the surgical management might have been modified, perhaps with a successful outcome, had the full significance of the roentgen findings been appreciated at the time.

A 53-year-old man, on Nov. 29, 1957, had sudden severe pain in the chest, radiating to the back, abdomen, and right leg, which during the next fifteen minutes became cold, numb, and powerless. When admitted to the hospital, the patient was in mild shock, though suffering considerable pain. He had a collapsing pulse of 84 (blood pressure 130/60 in right arm; 140/70 in left arm). The right leg was cold and white below the knee, with absence of all pulses, loss of power, and anesthesia. A diagnosis of dissecting aortic aneurysm was made and confirmed on exploration of the right iliac vessels. A fenestration type of procedure, with division and resuture of the external iliac artery, produced no appreciable improvement in the circulation of the leg.

The next day the patient's general condition was otherwise satisfactory, but hematuria appeared for the first time, suggesting serious renal artery involvement. Retrograde femoral aortography (Dec. 1) showed almost complete obstruction of the aorta above the renal arteries. The left common iliac artery was poorly outlined. No contrast medium was visible in the right common iliac artery. A more proximal decompression of the aneurysm was carried out on Dec. 2. Satisfactory circulation was restored to the lower limbs, and the operation was well tolerated. Oliguria persisted, however, and despite the adoption of a modified Bull's regime, the blood urea rose to 270 mg. per 100 ml., and the patient died five days after the second operation. Necropsy disclosed that the site of origin of the aneurysm was a tear in the aortic wall, 3 cm. in length and 2 cm. above the aortic valve.

The death of this patient from uremia strongly suggests that the operations failed to relieve the obstruction to the renal arteries, although delay between the two operations may have produced irreversible renal damage. It is felt in retrospect that the demonstration by aortography of bilateral renal-artery obstruction should have made obligatory a decompression fenestration procedure on the aneurysm in the thoracic aorta, and that this should have been supplemented by a further decompression of the right iliac artery.

The importance of detecting obstruction of the renal arteries is emphasized, and it is suggested that retrograde aortography may be effective in deciding what to do.

One roentgenogram; 3 drawings.

The Radiological Features of Syphilitic Aortic Incompetence. W. G. Smith and J. C. Leonard. Brit. Heart J. **21:** 162–166, April 1959. (W. G. S., Sully Hospital, Penarth, Glamorgan, Wales)

The authors studied the chest films of 83 patients with syphilitic aortic incompetence. Criteria of selection were strict, and patients with saccular aneurysm and gross aortic dilatation were excluded. Attention was directed to the cardiothoracic ratio, size of the left ventricle, size and shape of the aorta, pulmonary congestion and effusion, and aortic calcification. (Included in all but 10 cases was an overpenetrated postero-anterior teleroentgenogram made with stationary grid.)

The aorta and left ventricle were considered normal in 8 and 7 patients respectively. Two patients had entirely normal roentgenograms, thus indicating that syphilitic aortitis need not produce any radiological abnormality, even though aortic incompetence is present. Slight enlargement of the left atrium was noted in 3 patients. The cardiothoracic ratio exceeded 50 per cent in 62 cases, but this is only a rough guide to heart size.

Linear calcification of the ascending aorta was seen in 32 of the 83 patients (39 per cent); in 10 patients (12 per cent) the calcification was confined to the ascending aorta. The mean age of the 32 patients was sixty-two years, the youngest being forty-two.

The authors believe calcification of the ascending aorta to be a nearly specific sign of syphilitic aortitis. It rarely occurs in severe atherosclerosis and hypertension and, if so, the aortic calcification is likely to be widespread and to involve the ascending portion only to a slight degree. The importance of careful radiography for detection of early aortic calcification is stressed. Special studies including overpenetrated postero-anterior and oblique views and tomograms should be employed before linear calcification is pronounced absent.

It is concluded that calcification of the ascending aorta is a useful confirmatory sign in determining the etiology of aortic incompetence, and should be considered in conjunction with the clinical features, the serological reactions, and the erythrocyte sedimentation

rate. Occasionally it may be the only evidence of a syphilitic etiology.

Two roentgenograms; 1 table.

CHARLES M. GREENWALD, M.D.
Iowa City, Iowa

Intramural Aortic Dissection as a Complication of Translumbar Aortography. Earl F. Wolfman, Jr., and D. E. Boblitt. Arch. Surg. **78:** 629–638, April 1959. (University of Michigan Medical School, Ann Arbor, Mich.)

Injection of contrast medium into the aortic wall is believed to be a more common complication of aortography than is realized. The authors reviewed 302 translumbar aortograms and found some evidence of intramural dissection in 33 (10.9 per cent). There were 4 deaths in this series, of which 2 were directly attributable to a dissecting aneurysm; in the other 2 the association was more indirect. These 4 cases are reported.

Certain significant differences exist between intramural dissection and aortic thrombosis. One important point noted was the absence of collateral vessels in the presence of an apparent block. This means that the medium has been injected intramurally, since collaterals should be plentiful by the time complete thrombosis occurs.

Precautions to be observed to minimize the occurrence of intramural injection include: use of a short beveled needle; piercing of the aorta at a 90° angle; assurance of a good pulsatile flow from the needle before injection; use of a test film; manual injection; use of no more than 25 c.c. of the contrast medium; taking a twenty-minute delayed film; finally, familiarity with the complication, its roentgen features, and possible lethal outcome.

Eight roentgenograms; 2 photographs; 1 photomicrograph.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Communication Between the Anterior Aortic Sinus and the Right Ventricle Diagnosed by Thoracic Aortography. Jan Philipson and Georg-Fredrik Saltzman. Acta radiol. **51:** 283–288, April 1959. (Södersjukhuset, Stockholm, Sweden)

The authors report the case of a 34-year-old man with congenital cyanotic heart disease. This is one of the few cases of communication between the anterior aortic sinus and the right ventricle that has been diagnosed antemortem.

The authors emphasize the advantages of thoracic aortography for achieving a correct diagnosis when a distinction is to be made between an aortic septal defect, a ventricular septal defect with aortic insufficiency, and a communication between the aortic bulb and the right ventricle. In the case reported, the lesion was well demonstrated by aortography.

Surgery was undertaken to close the abnormal communication, but the patient died. The diagnosis was verified by autopsy.

Five roentgenograms; 3 diagrams; 1 table.

MAJ. NEIL E. CROW, M.C.
Lackland AFB, Texas

The Anomalous Origin of the Left Coronary Artery from the Pulmonary Artery. John D. Keith. Brit. Heart J. **21:** 149–161, April 1959. (University of Toronto, Toronto, Ont., Canada)

Anomalous origin of the left coronary from the pulmonary artery is a rare defect. It usually causes death within the first year of life. Some 50 cases have been reported since the first description in 1911, and the author has himself seen 10 more. He has found the anomaly to occur in 0.5 per cent of cases of congenital heart disease. The incidence in the child population is said to be 1 in 300,000.

Necropsy reveals the left ventricle to be grossly enlarged and somewhat thin-walled, with patchy fibrosis in the part supplied by the anomalous coronary. Changes would appear to be related to inadequate blood supply rather than to oxygen content of the blood delivered. At best, a coronary artery arising from the pulmonary receives blood under a relatively low pressure. If collateral circulation from the right coronary is sufficiently large the direction of flow may be reversed, the anomalous left coronary acting as a vein conveying blood into the pulmonary artery.

Angiocardiographic studies were performed in 5 of the author's cases, with opacification of the aberrant left coronary only once, although in the other 4 the pulmonary artery filled vividly. There is, then, both clinical and pathological evidence to suggest that the flow through the aberrant left coronary, whether in the conventional or in the reverse direction, is small and offers little or no nourishment to the tissues supplied by it. When the collateral circulation from the right coronary is poor, severe myocardial degeneration and fibrosis will lead to early death; when it is large, survival is possible into adult life.

This anomaly should be suspected in an infant in the first year of life who shows signs of heart failure, an enlarged heart, and electrocardiographic evidence of myocardial damage in the anterior portion of the left ventricle. Roentgenograms will reveal marked left ventricular enlargement, and the left atrium may be slightly or moderately enlarged. A venous angiogram will demonstrate a dramatically small right ventricle with a greatly enlarged rounded left ventricle. Thickness of the left ventricular wall can be determined, and this is of some importance, since dilatation is more a feature than hypertrophy. (The reverse is true in endocardial fibroelastosis.) As mentioned, demonstration of the anomalous coronary by this method is the exception rather than the rule because of the lower pressure in the pulmonary circulation and higher resistance in the coronary vessels.

The differential diagnosis includes those congenital heart anomalies that are associated with left ventricular hypertrophy or enlargement, such as endocardial fibroelastosis, tricuspid atresia, aortic stenosis, patent ductus arteriosus, coarctation of the aorta, ventricular septal defect, myocarditis, and coronary calcinosis. Most of these can be differentiated with relative ease, the greatest problem lying in differentiation from fibroelastosis when symptoms begin in the first year of life. The electrocardiogram will usually permit a definitive diagnosis, since the anomalous left coronary gives a pattern of myocardial damage associated with hypertrophy, while fibroelastosis simply presents evidence of left ventricular hypertrophy.

The diagnosis may be largely confirmed by selective aortography with the tip of the catheter just above the aortic valve. This will reveal filling of the right coronary from the aorta, and no filling of the left, thus indirectly establishing the diagnosis. It is of interest that the right coronary will frequently appear

dilated and tortuous since, besides its own circulation, it is providing blood to part of the left ventricle *via* collaterals.

Adequate surgery has not yet been evolved but it would appear possible that anastomosis might be completed between a segment of the aorta at the site of the left coronary and a systemic artery. If this were carried out early enough, before advanced myocardial change had occurred, normal heart function might result.

Eleven figures, including 3 roentgenograms; 1 table.

CHARLES M. GREENWALD, M.D.
Iowa City, Iowa

The Less Common Forms of Pulmonary Hypertension. William Evans. Brit. Heart J. **21:** 197–217, April 1959. (London Hospital, London, England)

The author describes the clinical and pathological findings in 11 patients with elevated pulmonary arterial pressure from diverse causes. In 3 cases, 2 with myxoma of the left atrium and 1 with strangulation of the pulmonary veins by a granuloma, in spite of the persistence for some time of an impressive rise of the pulmonary arterial pressure, true pulmonary hypertension had not ensued. Pulmonary hypertension is defined as the state "where a persistent rise in the pulmonary arterial pressure has been sufficient to cause hypertrophy, and ultimately failure, of the right ventricle, and where the electrocardiogram shows right ventricular preponderance."

The establishment of pulmonary hypertension is decided by obstruction within the pulmonary arteries, but the nature of this obstruction varies. In the large majority of patients with pulmonary hypertension histologic examination will reveal intimal proliferation as the cause of arterial block. The term intimal proliferation is favored over others as it allows the conception that the reactive material is the product of a localized reparative process. A constant feature of this intimal proliferation is its association with segmental hypoplasia of the media of the pulmonary muscular arteries.

Materials other than intimal proliferation produced the obstruction in 7 of the author's patients, all with true pulmonary hypertension. Occlusion in 2 cases was due to recurring pulmonary embolism and in 2 to emboli of neoplastic tissue, in 2 patients with pneumoconiosis to penetration of the arterial wall by the fibrotic lesion, and in 1 to the specific tissue of scleroderma. No example of occlusion by parasitic ova was encountered, although this is not a rare cause in some countries. Medial deficiencies were not found in this group in any significant numbers. This was also true of the 3 patients without true pulmonary hypertension.

The findings in these less common cases of elevated pulmonary pressure testify to intimal proliferation being the prelude to, and not the outcome of, pulmonary hypertension.

It is further postulated that in the absence of segmental deficiencies in the walls of the pulmonary muscular arteries, intimal proliferation leading to arterial obstruction with subsequent pulmonary hypertension does not take place. Furthermore, in the presence of medial hypoplasia, the formation of intimal proliferation is hastened by any condition that raises the pulmonary arterial pressure. In solitary pulmonary hypertension, where the pulmonary arterial pressure is normal at the start, intimal proliferation gains its stimulus from the presence of innumerable medial deficiencies.

The author's eleventh case was one of holo-hypertension, that is a combined or generalized hypertension with occlusion affecting both the pulmonary and renal arteries. Vessels in both locations showed identical changes with medial deficiencies and intimal proliferation. Holo-hypertension assumes greatest importance because of the difficulty of its diagnosis, the signs being modified in accordance with the relative severity of the systemic and pulmonary hypertension.

Twelve roentgenograms; 26 photomicrographs; 3 photographs: 10 electrocardiograms.

CHARLES M. GREENWALD, M.D.
Iowa City, Iowa

Anomalous Drainage of Entire Pulmonary Venous System into Left Innominate Vein. Clinical and Surgical Considerations. Denton A. Cooley and Harold A. Collins. Circulation **19:** 486–495, April 1959. (Texas Children's Hospital, Houston 25, Texas)

Total anomalous drainage of the pulmonary veins into the left innominate vein is usually fatal in infancy or early childhood, but a few patients reach adulthood. Surgical correction had been considered technically impossible until perfection of the cardiopulmonary bypass.

Roentgenograms of the chest in children reveal an almost pathognomonic cardiac silhouette, as described by Snellen and Albers (Circulation **6:** 801, 1952. Abst. in Radiology **61:** 674, 1953), who called attention to the "figure-of-eight " configuration of the mediastinum. In infants this pattern is not recognized. The superior mediastinal shadow may be widened, but the appearance is not at all characteristic of the anomaly. In this age group angiocardiography is useful in the delineation of the pulmonary venous collecting system. At cardiac catheterization the catheter may be passed into the anomalous venous connection and both lungs may be entered without the catheter entering the heart. The clinical picture in infants is that of congestive failure. In those who survive the pathognomonic "figure-of-eight" cardiovascular silhouette develops. They show exertional dyspnea, cyanosis, respiratory infections, and retardation of growth.

In the authors' surgical experience 2 patients were operated upon without the pump oxygenator but the anastomosis between the common pulmonary vein and the left atrium was inadequate and both died several hours later. With the pump oxygenator, 7 cases have been treated successfully, with repair of the atrial septal defect, enlargement of the left atrium by moving the septum forward, and anastomosis of the pulmonary venous trunk to the left atrium. Complete physiological correction is thus obtained and clinically the patients were considered cured.

Eight roentgenograms; 5 drawings; 1 table.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Arteriovenous Fistula of the Lung. Robert E. Foley and David P. Boyd. Dis. of Chest **35:** 422–427, April 1959. (Lahey Clinic, Boston, Mass.)

Arteriovenous fistula or aneurysm of the lung is a congenital shunt usually from a pulmonary artery to a pulmonary vein. Though it is rare, over 150 cases

have now been reported in the literature, most of them within the last fifteen years.

The patients usually seek medical aid with symptoms of decreased effort tolerance and with signs of cyanosis and clubbing of the fingers and toes. The malformation is visible on the plain roentgenogram of the chest as a rounded or lobulated area of increased density almost always within the middle or lower lobes, connected to the hilus by enlarged vascular shadows. Angiocardiography is the best method of establishing the vascular nature of the lesion.

The treatment is surgical excision and total removal can usually be accomplished by lobectomy.

One roentgenogram; 2 photographs.

MAJ. MARTIN A. THOMAS, M.C.
MacDill AFB, Fla.

THE DIGESTIVE SYSTEM

Variations in Roentgen Appearance of the "Esophageal Lip." Theresa L. Siebert, Joseph Stein, and Maxwell H. Poppel. Am. J. Roentgenol. **81:** 570–575, April 1959 (VA Hospital, Bronx 68, N. Y.)

Killian, a half a century ago, first described a fold on the posterior wall of the esophagus at its junction with the hypopharynx which he named the "esophageal lip." This bulge has been frequently ascribed to an abnormal swelling of the mucous membrane secondary to a foreign body caught in the esophagus. Observations in a 65-year-old white male with such a bulge, both at the time of original examination, when he had symptoms of dysphagia, and thirteen months later, when he was asymptomatic, led the authors to an investigation of 50 asymptomatic patients. In 36 of these a bulge of some degree was demonstrable roentgenographically.

The bulge was observed more frequently and was more prominent in the older age group. It seemed to bear no relationship to body build, nor was it directly related to the degree of spur formation demonstrated in the cervical spine. While always occurring at the same level in the same patient, its position varied in different patients from C-6 to T-1.

All of the 50 patients were asymptomatic in respect to past or present dysphagia and none was known to have disease in the region of the pharynx or esophagus. The authors share Killian's view that the "esophageal lip" is produced by the transverse fibers of the cricopharyngeus muscle. It appears to be of no pathologic significance.

Eleven roentgenograms; 2 tables.

ROSCOE E. MILLER, M.D.
Indiana University Medical Center

Oesophageal and Gastric Varices. K. T. Evans. Brit. J. Radiol. **32:** 233–240, April 1959. (Hammersmith Hospital, London, England)

The value of the barium swallow in demonstrating esophageal varices is considered in this study. Conclusions are based on findings in 100 patients with increased portal venous pressure. Each individual was radiographed in both oblique erect positions and in the right anterior oblique supine, in deep inspiration and sustained Valsalva and Müller maneuvers—a total of 9 views.

Small varices often could not be seen on fluoroscopy, and multiple views were found to be essential. The supine right anterior oblique view proved most informative; the Müller and Valsalva maneuvers were found to be of little value in demonstrating the varicosities. If the esophagus was contracted immediately following a peristaltic wave, varices were not seen. The best films were obtained on esophageal relaxation following simple inspiration.

The appearance varied from slight mucosal scalloping to very prominent globular and worm-like filling defects. In young people dilatation of the esophagus was found to be one of the earliest indications of the presence of varices.

Im 48 of the 100 patients splenoportal venography was carried out. In most of them esophageal varices were demonstrated both by barium swallow and by venography. In 4, barium swallow revealed large varices which venography failed to demonstrate. Several cases were found in which venography showed para-esophageal or gastric collateral circulation though no intraluminal varicosities were demonstrated. There also were a few patients with prominent varicosities demonstrable on barium swallow but with apparently normal venograms. It was felt, therefore, that both examinations are essential if surgery is contemplated.

Operations used by the author included portacaval anastomosis, transection of the esophagus, with ligation of veins, and splenectomy.

Twenty-one roentgenograms; 2 tables.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Roentgen Diagnosis of Benign Tumors of the Esophagus. H. P. Gockel. Radiol. clin. **28:** 1–19, January 1959. (In German) (Kaiserstr. 49, Mainz, Germany)

Benign tumors of the esophagus are not easily differentiated from varices, carcinoma, and sarcoma. They are usually solitary and may be either "exophytic" (intraluminal?) or intramural (intramucosal or submucosal). Six cases are reported by the author, with roentgenographic, esophagoscopic, and histologic observations.

The most frequent benign tumor of the esophagus is the leiomyoma, followed by polyps and fibromas. Pedunculated tumors are located chiefly in the upper esophagus. Leiomyomas for the most part involve the middle segment, as do also cysts.

Subjective symptoms are difficulty in swallowing solid foods, regurgitation, and pain, which may be either substernal or epigastric. Roentgenologically the tumor is seen as a smooth, rounded filling defect. The intraluminal tumors may be connected by a stalk to the esophageal wall and appear coated with contrast material. They exhibit some motility and may change in position with swallowing. There is sometimes widening of the esophageal lumen above the site of the larger tumors, and the mediastinum may also be widened. The intramural lesions are broad-based and require a tangential view for differentiation from extra-esophageal processes.

While the smooth filling defect is characteristic of a benign tumor, it is not invariable. The larger intraluminal tumors may show a net-like pattern due to irregularities of the overlying mucosa and sometimes to ulcerations. For cysts, change of form with respiration is typical. The filling defect caused by an intramural tumor is usually gradual and there is no displacement of the esophagus, which serves to distinguish it from an extra-esophageal neoplasm.

It is concluded that even a smooth, completely

regular filling defect does not warrant exclusion of a malignant lesion. Esophagoscopy is therefore always indicated, to be followed by exploration.

Twelve roentgenograms; 1 diagram.

ILONA D. SCOTT, M.D.
Lewisburg, W. Va.

Upper Gastrointestinal Bleeding. Roentgen Aspects. Don C. Weir. Missouri Med. **56:** 265–267, March 1959. (634 N. Grand Blvd., St. Louis, Mo.)

Since 1950, approximately 95 per cent of patients with massive bleeding have been examined within the first seventy-two hours of hospitalization at St. Louis City Hospital No. 1. Examination is performed after bleeding has stopped, if the patient is not in shock, and in exceptional cases on those still bleeding. Barium sulfate, 3 to 5 ounces in water solution, is used, and the examination is begun with the patient supine, without palpation. After completion of fluoroscopy, the patient is turned onto his abdomen and films are obtained in the postero-anterior, right anterior oblique, and right lateral projections. If there is suspicion of varices, films of the lower esophagus are made after a thick barium-water solution has been passed through.

In 1952, a consecutive group of 75 patients with massive bleeding were examined in a nine-month period. The bleeding lesion was verified by surgery or autopsy in 52 per cent of the cases and on repeated gastrointestinal studies in 30 per cent. Gastric or duodenal ulcer accounted for the bleeding in 67 per cent (duodenal ulcer in 50 per cent). Esophageal varices were responsible in 11 per cent and hiatus hernia in 8 per cent. In only 5 per cent was the cause of the bleeding undetermined. Three per cent of the examinations were unsatisfactory; in 11 per cent of the cases initial fluoroscopy failed to identify the lesion. Sources of error were superficial gastric ulcers and blood clots, which may simulate new growths or polyps. Double lesions also produced errors. Identification of esophageal varices does not necessarily indicate that these are the source of bleeding, for peptic ulcers may co-exist.

Seven roentgenograms; 2 diagrams.

GORDON L. BARTEK, M.D.
Grand Rapids, Mich.

Emergency X-Ray Examination in the Diagnosis of Severe Upper Gastrointestinal Bleeding. Stefan C. Schatzki and William R. Blade. New England J. Med. **259:** 910–912, Nov. 6, 1958. (Massachusetts General Hospital, Boston 14, Mass.)

Because of the seriousness of acute upper gastrointestinal hemorrhage, and the belief that the value and accuracy of x-ray examination in establishing the site of the bleeding have not been widely recognized, the results obtained at the Massachusetts General Hospital (Boston) from examining patients during their first thirty-six hours in the hospital after severe hemorrhage were analyzed. The series included all ward patients (whose records were available) who entered the hospital in 1957 with a history of acute gastrointestinal bleeding. Two basic criteria were demanded: (1) a history of acute gastrointestinal blood loss and (2) at least one transfusion (1 unit, or 500 ml. of blood) in the first twenty-four hours in the hospital. Cases with bleeding from below the ligament of Treitz were not included in the survey. One hundred and eight patients fulfilled the above criteria. Many of the patients had been in shock in the hours preceding roentgen examination, but none were in a state of shock at the time of fluoroscopy. Nearly all were receiving transfusions during the examination. The technic employed was that described by Hampton (Am. J. Roentgenol. **38:** 565, 1937).

Seventy-six of the patients had upper gastrointestinal examinations in the first thirty-six hours in the hospital, the great majority of the fluoroscopies being carried out in the first twenty-four hours. The remaining 32 patients were not examined in this period because of fractures, pneumonia, and other serious conditions, and 21 did not have a gastrointestinal roentgen examination at any time. A cause of bleeding was found in 58 patients at the first examination. No diagnosis was made in 15 cases, and a wrong diagnosis in 3; in 10 cases the cause of bleeding was still unknown at the time of the patient's discharge from the hospital; in 5 of the other 8 cases the fluoroscopist had considered the original examination unsatisfactory.

A review of the cases in the present series and those reported elsewhere indicates that no apparent morbidity is associated with the roentgen examination even though this is obviously difficult to evaluate accurately. Furthermore, there is no doubt in many radiologists' minds that there will be a significantly lower yield of positive diagnoses if fluoroscopy is delayed for seven to ten days. The increased difficulty in some instances of finding the lesion on a later examination is due to the rapid regression of the edema, spasm and other features of the acute peptic ulcer, as well as the rapid healing of the crater when the patient is placed on a medical regimen.

The clinician can aid the radiologist in three specific ways: (1) by providing a detailed history so that the examiner's index of suspicion may be high along certain channels; (2) by aspirating as much blood as possible from the stomach shortly before examination, since this adds to the difficulty of fluoroscopy; (3) by removing the gastric tube before examination, as it makes accurate study of the esophagus impossible and may produce artefacts leading to a great deal of confusion.

Two tables.

X-Ray Examination in Hemorrhage from the Upper Gastrointestinal Tract. Leo G. Rigler. Arch. Surg. **78:** 513–515, April 1959. (4833 Fountain Ave., Los Angeles, Calif.)

Serious gastrointestinal bleeding requires an accurate differential diagnosis as soon as possible, since the various causes require widely differing methods of treatment. The author recommends chest and abdomen films as a preliminary, followed by fluoroscopy of the esophagus with a small amount of barium. If no cause of bleeding is found, the examination proceeds to the stomach, with less barium than is ordinarily given. Postbulbar ulcers in particular should be kept in mind because of their bleeding tendency.

Pyelographic media may be used if there is a suspicion of impending perforation, but otherwise barium is best.

Care must be exercised, in view of the bleeding, not to mistake clots or masses of blood in the stomach or duodenum for tumors. Mottled shadows may well represent clotted blood.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

The Value of Delayed Gastric Emptying Roentgen Study of the Abdomen in the Detection of Ulcer, Carcinoma and Other Organic Disease of the Upper Alimentary Tract. Jay W. MacMoran, Robert B. Funch, and Barton R. Young. Am. J. Roentgenol. **81:** 609–612, April 1959. (Germantown Hospital, Philadelphia 44, Penna.)

The authors have used a standard upper gastrointestinal series followed by a further film of the stomach and duodenum at one hour for the diagnosis of gastric and duodenal ulcers, for a survey of small intestinal physiology and morphology, and to determine the degree of gastric emptying. They believe that the one-hour film demonstrates the mucosal pattern of the stomach to advantage; ulcers have sometimes appeared at this time even when not seen on the earlier examination. This is attributed to the smaller amount of barium in the stomach and the possible displacement of material adherent to the ulcer crater. Carcinomas and diverticula have also been demonstrated on the later film.

Of 100 cases, 83 per cent showed good visualization of the gastric mucosa at one hour. In 35 per cent of the cases an ulcer or carcinoma was better delineated than on the routine study; in 3 per cent the ulcer was seen for the first time.

Eight roentgenograms. G. E. COADE, M.D.
Indiana University Medical Center

The Meniscus Sign in Ulcerating Gastric Carcinoma. J. L. Boldero and K. Lumsden. J. Fac. Radiologists **10:** 80–85, April 1959. (Radcliffe Infirmary, Oxford, England)

The authors review the meniscus sign originally described by Carman as evidence of ulcerating gastric carcinoma. Although this sign is uncommon, it has been found by the authors to be a reliable index of malignancy. Five cases are reported in which it was present, and for comparison with them radiographs are reproduced of 4 simple ulcers, showing an appearance which is often confused with the meniscus.

What Carman, in his original paper (J.A.M.A. **77:** 990, 1921) likened to a meniscus was a dense radiographic shadow of barium in the crater of a particular type of malignant ulcer, when viewed in profile. The clear zone seen at the border of the crater in some cases of gastric ulcer is not the meniscus described by Carman, though it is frequently misinterpreted as such. It is not in itself a sign of malignancy, occurring in benign as well as malignant ulcers.

One point which needs to be emphasized is that absence of a projecting niche is a cardinal feature of the meniscus sign. The niche is a localized addition to the gastric shadow and is not seen in the type of carcinomatous ulcer described by Carman.

The meniscus may be somewhat irregular and the sign may sometimes be seen in a modified form. For instance, an ulcer on the lesser curve of the pyloric antrum can produce a meniscus with its concavity directed toward the gastric lumen instead of the gastric wall.

Judged upon its reliability, the meniscus sign is of value, but one must know exactly what it is in order to make proper use of it. Current misconceptions are likely to cause misdiagnosis of ulcers that are benign.

Twelve roentgenograms.

THEODORE E. KEATS, M.D.
University of Missouri

The Roentgen Appearance of the Stomach and Duodenum Following the Billroth I Gastric Resection. Soon Yong Kim and John A. Evans. Am. J. Roentgenol. **81:** 576–581, April 1959. (New York Hospital-Cornell Medical Center, New York, N. Y.)

The authors reviewed the charts and all available films of 60 random patients who had undergone a Billroth I gastric resection between March 1954 and September 1957. In 8 per cent of the cases, follow-up examinations revealed small pouch-like protrusions of mucosa along the reconstructed lesser curvature which suggested recurrent ulcers, while in 5 per cent there were filling defects of the lesser curvature, felt to be due to irregular suturing.

The size and configuration of the mucosal folds, both in the preanastomotic part of the gastric stump and the duodenum, depend on mechanical factors secondary to the operative technic and may be due to a disparity in the width of the gastric and duodenal ends of the anastomosis. Marked hindrance of barium passage through the anastomosis (with a feeling of fullness or sometimes vomiting) and asymptomatic delay in the passage of barium were far more frequently associated with enlarged mucosal folds in the preanastomotic area than with normal folds; this marked hindrance or delay occurred much more often in vagotomized patients.

All of the patients formed a new duodenal bulb, and an intermittent pyloric action at the stoma appeared at almost the same time.

Initially 15 per cent of the patients had definite dumping, and 10 per cent complained of symptoms suggestive of mild dumping. After nine months or later only 3 (or 5 per cent) had dumping symptoms. Of the 60 patients, 9 demonstrated rapid passage of barium through the small bowel, and 3 of these complained of dumping. Vagotomy was without effect in this respect. There was an increased incidence of dumping with more extensive gastric resections. No correlation of dumping with widening of the small intestine was found.

Nine roentgenograms; 2 diagrams; 5 tables.

RICHARD J. NOVEROSKE, M.D.
Indiana University Medical Center

Splenic Indentation of the Gastric Fundus Resembling Gastric Neoplasm. Report of Two Cases. Robert B. Brown and Robert P. Dobbie, Jr. Am. J. Roentgenol. **81:** 599–602, April 1959. (U. S. Naval Hospital, Bethesda, Md.)

The authors report 2 cases of vague upper gastrointestinal complaints due to indentation of the wall of the gastric fundus by the superior tip of the spleen. The defects so produced were clinically and roentgenographically indistinguishable from those attributable to true gastric neoplasms, suggesting an intramural polypoid lesion.

In each case the roentgenographic defect was consistently demonstrable on multiple examinations. Special attention was given in repeated studies to technics and position, but this resulted only in confirmation of the persistence of the original defect. In both cases the gastroscopist freely admitted that the area in question could not be satisfactorily visualized because of its position high in the fundus.

Surgical exploration proved both defects to be caused by the superior tip of a normal spleen in intimate and persistent contact with the greater curvature of the

stomach at the level of the defects demonstrable on the roentgenograms.

Four roentgenograms. ROSCOE E. MILLER, M.D.
Indiana University Medical Center

The Roentgen Diagnosis and Management of Prepyloric Narrowings. Robert S. Sherman, Ying-Ming Yen, Lemuel Bowden, and Henry M. Selby. Am. J. Roentgenol. **81:** 582–598, April 1959. (Memorial Hospital, New York, N. Y.)

This is a review of 23 histologically proved and roentgenologically similar prepyloric narrowings, 17 benign and 6 malignant. None of the patients had roentgen evidence of a mass or ulceration, nor was significant pyloric obstruction, retention, or gastric decompensation present. The basis for selection was lack of reliable roentgen signs to differentiate between cancer and benign disease.

Gastroscopy and cytology suffer obvious limitations for detection and diagnosis of lesions in this location. Palpation and inspection by the surgeon at gastrotomy can be unreliable; in a great many cases which seemed negative by this means but where roentgen evidence of an organic defect was present, there was pathological evidence of abnormality. When the surgeon described the stomach as normal or when scarring was present, the final diagnosis was always benign; when some degree of thickening or a mass was noted, final diagnosis was as likely to be cancer as not.

Comparison of the two groups revealed that narrowing seemed to be more severe in the benign cases, mucosal disturbance was more marked in malignant cases, and asymmetric stenoses were demonstrated in both. None of these criteria permits a specific diagnosis. The only significant roentgen finding was a faint double-contoured margin at the proximal edge of the lesion. This was found in 2 of the 6 cancer cases and was interpreted as being secondary to an abrupt and sharp border between cancerous and normal tissue—a sort of precursory finding to the overhanging edge so commonly encountered in annular cancers of the gastrointestinal tract.

The emphasis given by others to adhesions as an explanation for prepyloric constriction was not supported histologically by study of this group. Among the more unusual causes for prepyloric narrowing are syphilis, tuberculosis, leukemic infiltration, and lymphosarcoma. There was a high proportion of diagnoses such as edema, gastritis, muscle hypertrophy, superficial erosions, and metaplasia. Experienced radiologists when tested with some of this material offered diagnoses that were largely incorrect and not based upon factual knowledge.

Surgical diagnosis entails full-thickness biopsy in cases not presenting induration or a mass. Perhaps resection should be done in all these patients showing achlorhydria. Follow-up studies are indicated in benign narrowings without gastric retention or decompensation which are not treated surgically.

Twenty-nine roentgenograms; 26 diagrams.

P. M. INLOW, M.D.
Indiana University Medical Center

Hyperplasia of Brunner's Glands. Victor Berman and M. J. Goldberg. Brit. J. Radiol. **32:** 241–243, April 1959. (Johannesburg General Hospital, Johannesburg, Union of South Africa)

Brunner's glands, located in the mucosa or submucosa of the proximal duodenum, evidently serve by means of alkaline secretions to protect the duodenal mucosa from the acidity of the stomach contents. They are variable in size and may reach up to 5 mm. in diameter. The largest are found in the duodenal cap and upper part of the descending limb.

Hyperplasia of Brunner's glands may be of diffuse nodular, circumscribed nodular, or adenomatous type. The condition is associated with increased gastric acidity in contrast to duodenal polyposis, which is always accompanied by achlorhydria. No proved malignant changes have been reported in cases of Brunner gland hyperplasia.

The radiographic appearance is that of numerous well defined filling defects in the first and second portions of the duodenum. The hyperplastic glands are sessile, with no evidence of pedicles. Intestinal polyps are differentiated by the fact that they are not usually confined to the proximal duodenum, and they often are pedunculated.

A single case is reported.

Five roentgenograms.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Focal Constricting Inflammatory Lesions of the Small Intestine. Report of Three Cases. Lester W. Paul and Margaret C. Winston. Am. J. Roentgenol. **81:** 616–622, April 1959. (University Hospitals, Madison, Wisc.)

Three cases are reported showing localized concentric stenosis of the small intestine on an inflammatory basis but resembling radiographically annular carcinoma. Two patients had gastrointestinal complaints while the third presented with anemia due to chronic blood loss. Multiple lesions were present in 2 cases; in 1 there was a solitary lesion. Pathologically, one of the cases was thought possibly to be the result of vascular disease, while the other 2 appeared to be variants of regional enteritis. Roentgenographically, however, the lesions resembled annular carcinomas rather than the smooth, tapering constriction which is typical of regional enteritis. Multiple lesions of this type seen on a film present no difficult diagnostic problem, but single lesions must be differentiated from carcinoma, carcinoid, and primary ulcer of the small bowel.

Five roentgenograms. PHILLIP B. SISK, M.D.
Indiana University Medical Center

Tumors of the Small Intestine. R. Clement Darling and Claude E. Welch. New England J. Med. **260:** 397–408, Feb. 26, 1959. (Massachusetts General Hospital, Boston, Mass.)

Two hundred twenty-five primary small bowel tumors were observed in the Massachusetts General Hospital from 1913 to 1957: 93 were found at autopsy and 132 at operation. This study is concerned with the latter group, of which 46 were benign and 86 were malignant. Of 113 symptomatic cases, 18 (16 per cent) were in the duodenum; 48 (42 per cent) in the jejunum; 47 (42 per cent) in the ileum.

A total of 56 symptomatic patients in the series had barium studies of the small bowel. The diagnosis of neoplasm was made radiologically in 16 cases by an upper gastrointestinal series, in 27 by a small-bowel series, and in 4 by enema, a total of 47 correct diagnoses, or 84 per cent.

Of the 86 primary malignant tumors, all but 1 were

symptomatic. These included, in order of frequency, carcinoma, malignant lymphoma, carcinoids, and leiomyosarcoma.

The 46 benign tumors were treated without mortality. Of the 54 patients with malignant lesions who had resections for cure before Jan. 1, 1953, 16 (30 per cent) died postoperatively; 47 per cent of the survivors were living and free of disease five years later.

Although there were numerous exceptions, several diagnostic features of interest are cited: "Tumors found incidentally at laparotomy are nearly always benign; obstruction is usually chronic and remittent (when acute small bowel obstruction is due to intussusception in adults a tumor of the intestine is involved in about half the cases and the lesion is usually benign); intestinal bleeding is common with all tumors except carcinoids, in which it was encountered in only 13 per cent of the cases in this series; a palpable mass nearly always indicates a malignant tumor (when the mass is tender, a lymphoma should be suspected); perforation is common with lymphoma and sarcoma (it is rare with cancer and was not encountered with carcinoid or benign tumors)."

Nine figures, including 2 roentgenograms; 7 tables.

Lymphosarcoma in the Terminal Ileum. David H. Baker and Kenneth M. Jensen. Gastroenterology **36**: 528–533, April 1959. (New York Hospital, New York 21, N. Y.)

The authors report a case of lymphosarcoma of the terminal ileum in a 4-year-old girl, leading an intussusception into the ascending colon. Barium-enema study demonstrated a large mass in the region of the cecum which was interpreted as a tumor. Ileocolic intussusception was not considered preoperatively. The diagnosis was made at surgery, and postoperative irradiation was utilized.

A brief review of the literature regarding the incidence of lymphosarcomas of the intestinal tract is presented. This neoplasm is said to represent approximately 6 per cent of malignant tumors in infants and children, and only a fraction of these are found to be primary in the small bowel. However, small bowel tumors of any type are rare in childhood, and their presence should suggest the possible diagnosis of lymphosarcoma.

Two roentgenograms; 2 photomicrographs; 1 photograph.

RICHARD H. GREENSPAN, M.D.
University of Minnesota Hospitals

The Small Intestine in Whipple's Disease. William Martel and Fred Jenner Hodges. Am. J. Roentgenol. **81**: 623–636, April 1959. (University Hospital, Ann Arbor, Mich.)

Whipple's disease is characterized by intestinal malabsorption and specific pathologic findings. The latter include thickening of the intestinal wall and mucosal folds. The esophagus, stomach, and colon are not involved. The small bowel mesentery is frequently thickened and edematous and the mesenteric and retroperitoneal lymph nodes are enlarged. The mucosa of the bowel is infiltrated by large mononuclear macrophages having a foamy granular cytoplasm. The cells react positively to the periodic acid Schiff (P.A.S.) test.

The authors report 3 cases with specific reference to the roentgen findings in the small intestine, one with a complication of cecal volvulus. The thickening of the mucosal folds in the duodenum and jejunum is reflected roentgenologically. Minimal dilatation of the bowel lumen was seen in one case, though not as marked as that usually seen in idiopathic sprue. Segmentation occurred and is explained on the basis of increased mucus secretion due to irritation by unabsorbed fatty acids. Transit times were normal.

Eight roentgenograms; 3 photomicrographs.

CHARLES H. HELMEN, M.D.
Indiana University Medical Center

Meckel's Diverticulum: X-ray Diagnosis. Alfred S. Berne. New England J. Med. **260**: 690–696, April 2, 1959. (Memorial Hospital, Syracuse, N. Y.)

The author briefly reports 5 cases of Meckel's diverticulum, in 4 of which the diagnosis was made preoperatively.

In 1812 Meckel described the congenital diverticulum of the small intestine which now bears his name. It is said to occur in 1 to 2 per cent of all autopsies. The incidence is three times higher in males than in females. The diverticulum occurs on the anti-mesenteric side of the intestine and includes all layers of the intestinal wall. It may contain, also, ectopic mucosal or pancreatic tissue.

Meckel's diverticulum is subject to a variety of complications, including inflammation, peptic ulcer, obstruction, intussusception, and neoplasms. Neoplasms are generally of the benign type, such as lipomas, myomas, etc., but carcinoids, carcinomas, and sarcomas have been described.

Roentgen demonstration of Meckel's diverticulum is unusual. This has been attributed to lack of uniformity in the location and size of the anomaly, to the fact that it is frequently filled with nonopaque matter, which prevents filling with contrast material, and to the transient nature of filling, when this does occur, as a result of the contractions of the diverticular wall. The plain abdominal film may show evidence of intestinal obstruction and may reveal the presence of gas not conforming to the usual bowel pattern. The finding of calculi demonstrable as calcific rings or laminated calcium margins lying within a gas shadow is very suggestive. Barium studies frequently show the diverticulum as a finger-like projection from the ileum. Occasionally the diagnosis can be suspected from detection of a collection of barium unconnected with the intestinal lumen and not conforming to the barium pattern in the small intestine. In the contrast-filled diverticulum it may even be possible to demonstrate mucosal folds, changes in size, or an ulcer crater.

Thirteen roentgenograms; 2 photographs.

PAUL MASSIK, M.D.
Quincy, Mass.

A New Method of Air Contrast Examination of the Colon for Routine Application. M. H. Nathan and A. Newman. Am. J. Roentgenol. **81**: 675–677, April 1959. (Jefferson Davis Hospital, Houston, Texas)

The double-contrast study is an important complement to the barium-enema examination for demonstrating the presence or absence of pathologic change in the colon. A complete air-contrast study, however, is impractical as a routine procedure, and the authors have therefore devised an abbreviated technic requiring no fluoroscopic control and employing only one additional film. Following the usual fluoroscopic and roentgenographic examination, a measured volume of air, equal to the amount of barium used initially, is

introduced into the colon. One of the simplest methods of doing this is by means of a rubber insufflation bulb. A single film of the abdomen is then obtained.

In 1,027 cases the authors have had no complications with this procedure. It is not recommended when there is any clinical suspicion of polyp formation or in the presence of melena. In these circumstances, the air is introduced into the colon under fluoroscopic control, and spot roentgenograms are made along with a much more extensive roentgenographic examination.

Two roentgenograms. JOSEPH P. TOMSULA, M.D.
Baton Rouge, La.

Sigmoid Volvulus: Variations in the Roentgen Pattern. Leo S. Figiel and Steven J. Figiel. Am. J. Roentgenol. **81:** 683–693, April 1959. (Grace Hospital, Detroit 1, Mich.)

A long and freely movable sigmoid loop, either congenital or acquired, is necessary for the occurrence of sigmoid volvulus. In the younger age groups, the condition may develop rapidly, with a relatively sudden onset of generalized cramping abdominal pain and vomiting. The disease may acquire its full pattern in less than twenty-four hours. In older patients the onset is notably slower. There may be a history of previous attacks and chronic constipation. Lower abdominal pain with cramping and vomiting may not appear until the fifth or sixth day.

Classically, cases of sigmoid volvulus present the features of severe distention of the sigmoid flexure and marked accumulation of fluid in the obstructed sigmoid loop. Fluid levels can readily be demonstrated in the ascending and descending sigmoid segments with the patient in the erect or appropriate lateral decubitus position.

In 60 to 70 per cent of the authors' series of 45 cases the obstructed sigmoid loop was predominant in the abdomen and the appearance was quite characteristic. In 30 to 40 per cent the distended bowel deviated either to the right or left flank. In some of this latter group it was extremely difficult to recognize the sigmoid, and an enema study was necessary to confirm the diagnosis.

Definite recognition of sigmoid volvulus is of importance so that proper surgical measures may be taken early.

Nineteen roentgenograms; 1 diagram.

JOSEPH P. TOMSULA, M.D.
Baton Rouge, La.

Pneumatosis of the Descending Colon. Kennedy Creevey, Jerome L. Cohen, and George J. Riley. New England J. Med. **259:** 912–915, Nov. 6, 1958. Samaritan Hospital, Troy, N. Y.)

Pneumatosis cystoides intestinalis is a rare condition characterized by the presence of gas-filled cysts involving the intestinal wall and its attachments. In a review published in 1952 (Arch. Path. **53:** 523, 1952. Abst. in Radiology **60:** 619, 1953), Koss gathered reports of only 213 cases of pneumatosis intestinalis from the world literature. Excluding 32 heterogeneous cases, these fell into three main groups: 134 cases involving the small intestine, most commonly associated with peptic ulcer and obstruction of the stomach; 34 cases involving the cecum, thought to be secondary to disease of the cecum or appendix; and 13 cases involving the rest of the colon. According to the present authors, approximately 10 cases of pneumatosis of the descending colon have since been reported. They add another, which was unusual in that there was no primary underlying disease.

The patient was a 53-year-old woman, who complained of abdominal gas, with alternating constipation and diarrhea, of three months duration. Barium enema studies showed what was considered to be regional ulcerative colitis with polypoid changes. Surgical exploration was negative except for the region of the splenic flexure, where about 20 cm. of the bowel was involved in a localized process. The bowel wall contained gas-filled cysts, varying up to 2 cm. in diameter, and there were small foam-like areas in the immediately adjacent mesentery and fat. The resected intestine revealed typical pneumatosis cystoides, with gas cysts in the submucosa and subserosa.

Pneumatosis of the colon can be diagnosed roentgenologically. The cluster of air shadows shows up on a scout film, and their location in the intestinal wall is demonstrated by barium-enema examination. The barium column is irregular and surrounded by translucent shadows of variable size that cause indentation in the wall of the colon. The irregular pattern of the intestine, however, is suggestive of colitis, polyposis, or even carcinoma. The air cells can very easily be overlooked, chiefly because the disease is unexpected and unfamiliar. The occurrence of pneumoperitoneum should suggest the possibility of pneumatosis.

Two roentgenograms; 1 photomicrograph.

The Role of Splenoportography in the Diagnosis of Epigastric Tumors. J. Rösch. Fortschr. a. d. Geb. d. Röntgenstrahlen **90:** 415–434, April 1959. (In German) (Zentral-Militär-Krankenhaus, Prague, Czechoslovakia)

The author's experience with splenoportography includes 207 examinations on 189 patients. The epigastric tumors cause multiple changes in the form, course, and diameter of the veins. Splenoportography not only determines the presence of tumor of the liver but may also show its position and size, the presence of metastasis, and sometimes even give valuable information as to its nature.

A small solitary malignant tumor of the liver causes only minimal changes in the contrast-filled branches of the veins. In the phase of opacity there will be a "spot" (lack of contrast material) corresponding to the tumor. In the author's opinion, masses of 1 cm. in diameter can be identified in the mid portion of the liver.

The larger solitary liver tumors, of 2 to 3 cm., cause a deformity of the branches of the greater vessels. The vessel walls adjacent to the tumor are irregular in contour, some are amputated, and avascular foci are present. The opacity is not homogeneous. With the growth of the mass, the avascularity increases, sometimes to the point that an entire lobe may be avascular. The extrahepatic vessels are slightly widened and the portal vein may be displaced. Usually there is no collateral filling; if it is present, it is usually the sign of a thrombosis of one of the larger venous branches.

With multiple small metastatic foci, the vessel walls are straighter, the normal curvature is missing, and the vessels often branch off at an obtuse angle. The arborization is usually poor. The greater vessel branches are narrower and stiffer; the lumen is irregular and sometimes biconcave. In the phase of opacity the characteristic picture of the "perforated liver" is seen.

The appearance of the benign tumors, except for

cavernous hemangiomas, is very similar to that of malignant solitary tumors. After the tumor reaches a certain size there will be pressure on the vessels. The deformed vessels, however, are smooth, with no evidence of amputation. There is also a compensatory hypertrophy of the normal parenchyma. The cavernous hemangiomas show numerous widened, irregular, twisted veins; the blood circulation is slowed down, and the contrast material shows some puddling.

Splenoportography is helpful in gastric tumors to establish the presence or absence of metastasis. While not all metastases can be demonstrated, a certain amount of information as to the operability of the lesion is obtained.

The diagnosis of gallbladder tumors by splenoportography is possible only when the tumors are relatively large and extend into the hilus of the liver, the great veins, or the liver itself. With large gallbladder tumors there is a deformity of the portal veins and there may be changes in the right lower lobe of the liver.

Splenoportography is important in colonic tumors, especially where, during surgery, palpation and inspection of the liver are not possible. With tumors which are located in the right or left flexure of the colon it is possible by splenoportography to determine extension dorsally in the neighborhood of the hepatic and splenic veins.

With splenoportography it is possible to diagnose pancreatic tumors earlier than with any other known method as long as the tumors are located in the body or in the tail of the pancreas. These tumors spread dorsally. Those which originate from the anterior surface of the pancreas and grow forward are usually not demonstrable.

The diagnosis of retroperitoneal tumors by splenoportography is limited to those which originate in or extend to the splenoportal trunk. The advantage of this method is that, to a certain extent, the character of the tumor also can be determined. Expansive tumors cause pressure changes and the splenoportal trunk is displaced; the collateral circulation is usually not marked. Infiltrative tumors of the portal system show early changes, the tumor grows into the lumen of the vessels, blocks them, and causes a collateral circulation.

Splenoportography does not add significantly to the diagnosis of tumors of the kidneys and adrenals.

Twenty roentgenograms; 1 table.

ILONA D. SCOTT, M.D.
Lewisburg, W. Va.

Radiology of Acute Pancreatitis. D. F. Cantwell and A. V. Pollock. J. Fac. Radiologists **10:** 95–99, April 1959. (General Infirmary, Leeds, England)

The authors review the radiology of acute pancreatitis based on radiography of 88 patients with this disease. Plain films of the abdomen are useful in a negative sense, in establishing a diagnosis other than pancreatitis. Cholecystography during the first two weeks of the illness always shows abnormal gallbladder function.

The barium-meal examination is most rewarding. It was done in 43 of the cases in the present series and in 25 showed abnormalities. In 14 of the patients there was an irregularity of the gastric mucosal pattern; 11 patients showed forward displacement of the stomach. In addition, elevation of the pyloric antrum may also be seen. In 6 patients the duodenum was dilated and the films revealed pooling of the medium. One of these also showed jejunal dilatation. Six patients showed enlargement of the duodenal loop.

Eight patients had cholangiograms, 1 operative and 7 intravenous; 4 were normal, 4 abnormal. Of the 4 abnormal cholangiograms, 1 showed a dilated common bile duct and 3 showed no excretion of the medium in the biliary system.

Operative pancreatography is a simple, probably not very safe procedure which does not yield as much information as had been hoped.

Chest radiography may sometimes be useful. In 10 patients abnormalities were seen on the chest film. In 6 patients the left diaphragm was elevated, and 6 had a left pleural effusion or inflammatory changes at the left base. In 8 cases the right dome was elevated, and in 2 of these there was an associated pleural effusion.

The barium-meal examination not only is most informative from the diagnostic point of view, but it does not distress the patient if carried out with discretion. Furthermore, it demonstrates in particular one of the complications of the condition, namely the presence of a pseudopancreatic cyst. In the case of conservative treatment of such a cyst, comparison of films taken at intervals may show reduction in the retrogastric mass with improvement in the patient's condition.

Eleven roentgenograms.

THEODORE E. KEATS, M.D.
University of Missouri

Diagnostic Value of Radiologic Studies in Liver Disease. Harry J. Perlberg, Sr., Harry J. Perlberg, Jr., and Carroll M. Leevy. J. M. Soc. New Jersey **56:** 163–168, April 1959. (Jersey City Medical Center, Jersey City, N. J.)

Currently available radiologic procedures of aid in studying the functional status of the liver are evaluated in this article.

Modifications of standard technics for abdominal scout films and barium esophageal studies increase the diagnostic worth of the procedures in serial estimation of the size of the liver and in the detection of esophageal varices in hepatic cirrhosis. Cholecystography aids in estimating hepatic functional reserve and permits discovery of unsuspected gallstones in established liver disease. Cholangiography is indispensable in ruling out extrahepatic lesions in patients with persistent jaundice attributed to intrahepatic mechanisms leading to biliary obstruction. Percutaneous splenoportography and hepatophlebography are invaluable in studying the patient with portal hypertension; they facilitate recognition of vascular anomalies and space-occupying lesions and serve as a guide in hepatic vascular surgery.

Four cases are reported.

Eleven roentgenograms; 1 table.

New Iodine Compounds for Hepatolienography. Robert J. Dummel, James D. Madden, and Sydney F. Thomas. J. Am. Pharm. A., Scient. Ed. **48:** 181–182, March 1959. (Palo Alto Medical Research Foundation, Palo Alto, Calif.)

The ideal compound for hepatolienography should be chemically inert, water insoluble, easily dispersed to a stable colloid, and subject to slow elimination from the organism. The authors report their experiments with the tetraiodophthalic anhydride derivatives. Hydroxyethyl and hydroxypropyl tetraiodobenzoates

prepared by decarboxylation of hydroxyethyl and hydroxypropyl tetraiodophthalates gave good colloidal dispersions by precipitation in water from acetone. Low toxicity of zirconyl salts and tetraiodophthalate was the basis of attempts to prepare zirconyl tetraiodophthalate, but hydrolysis took place in attempts to neutralize the solvent. The experimental reports on the above substances are included.

GORDON L. BARTEK, M.D.
Grand Rapids, Mich.

Radiology of Calcified Hydatid Cysts of the Liver. E. de Arzúa Zulaica. Rev. clín. españ. **73:** 53–58, April 15, 1959. (In Spanish) (Bilbao, Spain)

The author advocates radiography with soft-tissue technic on old cases of hydatid disease with liver enlargement and states that calcifications will be perceptible in far more than the 10 per cent usually mentioned. The cysts are frequently multiple, and when one is found others must be sought. In about 85 per cent the site is in the right lobe of the liver.

Calcification may be total, indicating quiescence, or partial, which implies cystic activity and calls for surgical attack. The totally calcified cysts are very dense, and the contour may be circular, oval, or irregular. At times the thick capsule may mask activity still remaining inside the cyst. The decision whether calcification is total or partial may therefore be difficult. [No mention is made of any experience with laminagraphy in such cases.—D.E.M.]

When calcification is partial, the radiographic image is inhomogeneous, striped or splashed with grains or rays, trabeculated, or marbleized with shadows of varying density. The cyst wall is usually seen as a fine line, well defined externally, but unsharp inwardly. In the early stages only a sickle-shaped calcific line may be apparent.

Size may vary from that of a small nut to a fetal head. Cysts may be multilobulated or multivesicular. If there are pockets or diverticula, these too may be partially or totally calcified along with the main cyst. At times there may be communication with the biliary tract or other neighboring organs. Suppuration and gas formation are not uncommon in such cases.

In differential diagnosis consideration must be given to the confusing shadows which may be presented by such lesions in the liver parenchyma as cancer, tuberculoma, or stone, as well as infarct, amebic abscess, phlebolith, biliary or renal calculus, pancreatic calcification, renal or pancreatic abscess, and costal calcification. Upright and oblique radiographs, intravenous cholangiograms and pyelograms, and films made during abdominal compression or in different phases of respiration will usually make the differentiation.

Eosinophilia and skin sensitivity reactions are not always reliable indices of activity; and since surgical intervention is always a major undertaking, it is permissible in some cases to observe the development of a cyst and its calcification for a month or two. If calcification is partial, and is not seen to change, one can assume that it is not going to become total, and surgery must be undertaken. When the cyst size is seen to increase, surgery is also indicated. Total calcification warrants nonintervention.

Sixteen roentgenograms.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

The Radiology of the Bile Ducts. E. Alan Price. Brit. J. Radiol. **32:** 247–254, April 1959. (Johannesburg General Hospital, Johannesburg, Union of South Africa)

The author discusses biliary tract abnormalities in the light of his findings on 190 intravenous cholecystograms. The various abnormalities are broken down under a number of subheadings:

Anomalies: The value of intravenous cholecystography in diagnosing preoperatively congenital abnormalities of the ducts is briefly mentioned.

Injuries: In 5 cases with duct injuries and external bile fistulas the ducts were not visualized. They were well opacified in only 3 of 10 cases of injury (8 surgical) with internal biliary fistulas. Gas was seen, however, in the duct or gallbladder in almost all of these patients.

Adhesions: In 10 cases adhesions of the ducts was suggested by an irregular course of ducts with single or multiple angulations; abrupt dilatation of the proximal duct when the distal part showed normal caliber; hour-glass type constriction of a portion of the duct; stasis of contrast medium proximally with normal emptying distally.

Cholangitis: No findings characteristic of cholangitis were identifiable.

Stones: In 21 cases duct stones, usually nonopaque, were detected. Several cases are mentioned and one is described in which a common duct stone formed a diverticulum-like pocket in the distal duct so that it was missed on exploration although shown on the intravenous cholecystogram. Widening of the duct at the stone site is called the "wooden club sign" by the author. A "crescent sign" is also described, due to incomplete obstruction of the duct by the stone, with production of a shadow resembling the quarter moon.

Dilatation: Choledochectasis is felt by the author to indicate past or present disease. He feels that compensatory physiological dilatation of ducts after cholecystectomy is unlikely. The radiologic signs of obstructive dilatation are: poor density of the contrast-filled duct; increase in the density of the duct on the two-hour film as compared with the one-hour film; loss of normal tapering of the distal part of the common duct; delay of appearance of medium in the duodenum; presence of duct stones, stricture, adhesions, or pancreatic calculi.

Cystic duct stump: Radiographic studies may assist in diagnosing two disorders of the cystic duct stump: stone in the stump and pouch formation due to inflammatory changes.

The author suggests that most cases of so-called "biliary dyskinesia" are probably due to organic causes. He proposes that the term "choledochopathy" be used whenever a biliary duct lesion is suspected.

Nine roentgenograms; 1 diagram.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Absorption of Iopanoic Acid and Its Sodium Salt. K. H :son Holmdahl and H. Lodin. Acta radiol. **51:** 247–250, April 1959. (University Hospital, Uppsala, Sweden)

The diagnostic reliability of oral cholecystography depends largely on the degree of absorption of the contrast medium employed. Diminished absorption of contrast medium results in uncertainty of assessment of an incompletely filled gallbladder and large amounts of the material remaining in bowel.

The authors compared the blood levels of iodine in 26 patients, 13 given iopanoic acid (Telepaque) and 13 given its sodium salt (Bilijodin-Natrium). The results showed a significant increase in blood levels of the sodium salt patients over those taking iopanoic acid. The time of absorption in both groups was similar; the peak blood levels were obtained in four to six hours after ingestion.

The authors conclude that the sodium salt of iopanoic acid is more satisfactory for oral cholecystography than iopanoic acid.

One graph. CAPT. ALLAN E. GREEN, JR., M.C.
Lackland AFB, Texas

Effect of Tricyclamol on Gastric Emptying and Intestinal Transit. Comparative Studies with Placebos, Single Dose, and Optimal Effective Dose. David C. H. Sun, Harry Shay, and Henry J. Woloshin. Am. J. Digest. Dis. **4**: 282–288, April 1959. (Temple University Medical Center, Philadelphia, Penna.)

Effects of orally administered Tricyclamol, an anticholinergic drug, were investigated in 9 patients with chronic duodenal ulcer. Three studies were done on each patient on different days, with each one serving as his own control. Effects on gastric emptying of the barium meal and Ewald meal were determined following administration of a placebo, a single 50-mg. dose of the drug, and the optimal effective dose, "optimal effective dose" (OED) being defined as one dose increment below which no uncomfortable symptoms of parasympathetic inhibition are produced. This dose is determined empirically for the patient and is ordinarily found to be considerably larger than the commercially available dose unit.

Stomach emptying was judged by interval filmings of the abdomen at one, two, and four hours. No significant differences were found in the rate of gastric emptying following either the placebo or the single 50-mg. dose of Tricyclamol. When the OED was given, however, a gastric emptying delay of mild degree was observed at one- and two-hour intervals but not at four hours. There appeared to be a mild delay in progress of the barium through the small bowel after medication with Tricyclamol as compared with that following the placebo. Pertinent data are presented in one large table. Nine small roentgenograms show the progress of meals. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Absorption of Urokon from the G. I. Tract. Ralph M. Lilienfeld. Acta radiol. **51**: 251–256, April 1959. (Roswell Park Memorial Institute, Buffalo, N. Y.)

In 5 of 19 cases examined with a contrast medium consisting of 60 ml. Gastrografin 76 per cent in aqueous solution with an anionic wetting agent, radiographic evidence of absorption of the medium from the gastrointestinal tract was obtained. In 3 of these cases there was a possibility of a direct communication between the intestinal tract and the vascular system as the result of a pathological condition.

Subsequently, 25 normal patients were studied following ingestion of 50 microcuries of radioactive Urokon. Approximately one-fifth of the Urokon was excreted in the urine in twenty-four hours; 3 per cent was concentrated in the thyroid. Modifications of the contrast medium by use of an anionic wetting agent, a nonionic wetting agent, and by acidification had no appreciable effect on absorption. Alkalinization reduced absorption and is recommended also to prevent precipitation of the contrast medium in the stomach.

When the concentration of administered Urokon was increased by adding 5 ml. of 70 per cent carrier Urokon to the 50 microcuries of radioactive Urokon, the twenty-four-hour urine samples contained only 6.3 to 11 per cent of the administered dose. Not only was there a decrease in urinary excretion of Urokon at the higher dose but there was also a decrease in 24-hour total urine excretion (because of the increased osmolarity of Urokon at high concentration, causing a diffusion of fluid into the bowel lumen).

The author concludes that absorption of Urokon in diagnostic concentration from the normal gut is limited.

Two roentgenograms; 2 tables.
MAJ. BYRON G. BROGDON, M.C.
Lackland AFB, Texas

THE MUSCULOSKELETAL SYSTEM

Contribution to Differential Diagnosis of Benign Giant-Cell Tumors of the Bones. E. Kotscher. Radiol. clin. **28**: 19–24, January 1959. (In German. (Zentral-Röntgeninstitut der Universität Wien, Vienna, Austria)

The diagnosis of benign giant-cell tumors is difficult, often requiring biopsy. The author reports the case of a 16-year-old boy, who gave a history of swelling of the left leg, adjacent to the knee joint, for three or four months. Roentgen examination showed an osteolytic defect of the metaphyseal end of the tibia, surrounded by thickened bone. Posteriorly the cortex was thin, but not broken. The process extended to the epiphysis. Tomography showed, in the center of this osteolytic defect, a rather large irregular bone shadow, indicating a benign, slow-growing lesion, which allows the surrounding bone to react with sclerosis. An inflammatory process with sequestrum was excluded by the clinical history. Operation revealed a typical giant-cell tumor.

This case is of interest because of the youth of the patient, the location of the tumor (metaphysis), and the marked sclerosis around the area of destruction. The author believes it represents a far advanced giant-cell tumor, probably in a healing stage.

Three roentgenograms. ILONA D. SCOTT, M.D.
Lewisburg, W. Va.

Léri's Pleonosteosis. A Study of a Family with a Review of the Literature. John G. Rukavina, Harold F. Falls, John F. Holt, and Walter D. Block. J. Bone & Joint Surg. **41-A**: 397–408, April 1959. (University of Michigan, Ann Arbor, Mich.)

Pleonosteosis, also known as Léri's syndrome, is a rare congenital and hereditary condition which involves chiefly the connective tissue system. A typical syndrome consists of the following features: (1) shortness of stature, (2) mongoloid facies, (3) short, spade-like hands, (4) broad thumbs in valgus position, (5) genu recurvatum, (6) flexion contractures of the digits of the hands and feet, (7) cubitus valgus, and (8) limitation of motion of the articulations of the body.

The authors observed the syndrome in several members of one family and believe this to be the first example of familial occurrence in North America. The roentgen findings included short, broad metacarpals,

metatarsals and phalanges, enlargement of the vertebral bodies, and coarse trabeculae, resembling acromegaly. The cervical spine showed increased vertical height of the posterior neural arches, contributing to lordosis of the neck. The sinuses were enlarged. It is pointed out that the roentgen findings vary from one patient to another and that, taken alone, they are not absolutely diagnostic but rather suggestive of the syndrome.

Differential diagnosis should be made between Léri's syndrome, gargoylism, and congenital syphilis.

Four roentgenograms; 3 photographs; 1 photomicrograph; 1 pedigree chart. J. S. ARAJ, M.D.
Toledo, Ohio

Observations on Changes of Pattern in Chronic Pyogenic Osteomyelitis Following Inadequate Administration of Penicillin: Their Similarity with Other Bone Diseases. K. S. Bose. J. Indian M. A. **32:** 271–273, April 1, 1959.

Atypical Osteomyelitis—Modified Features of Osteomyelitis Following Inadequate Penicillin Therapy. (Its Similarity with Malignant Bone Tumours.) K. S. Bose. Indian J. Surg. **21:** 88–94, February 1959. (Medical College, Calcutta 12, India)

In these two articles the author shows how the standard clinical and radiographic picture of pyogenic osteomyelitis has been altered since the introduction of penicillin therapy. Seven cases are presented and discussed in one paper, and 5 in the other. Instead of the typical appearance of involucrum and sequestra formation usually seen in pyogenic osteomyelitis, the author observed radiographic patterns simulating various bone diseases such as Paget's disease, Ewing's tumor, osteogenic sarcoma, osteoid osteoma, infantile cortical hyperostosis, and Gaucher's disease. Histopathologic diagnosis is often inconclusive in differential diagnosis. Culture of biopsy material is of importance if there is bacterial growth. Clinical observation over a few weeks will usually make differentiation possible. Arteriography may be helpful. The author points out that most of these atypical cases appear after inadequate treatment with penicillin.

Thirteen roentgenograms; 2 photomicrographs; 1 table. J. S. ARAJ, M.D.
Toledo, Ohio

The Natural History of Osteomyelitis Variolosa. Peter Cockshott and Malcolm MacGregor. J. Fac. Radiologists **10:** 57–63, April 1959. (University College Hospital, Ibadan, Nigeria)

The authors review the clinical aspects of smallpox osteomyelitis based on experience with 34 cases seen at the University College Hospital in Ibadan (Nigeria). Bone infection may be noted any time between one and six weeks from the beginning of the disease. The severity of the bone and joint lesions does not bear any relationship to the clinical severity of the smallpox.

There are two main clinical types of this disorder: bone disease with arthritis and bone infection alone. The latter is less frequent, appearing in older children, and seems to be the result of a localized infection of the shaft of a bone rather than the more usual metaphysial disease with joint involvement.

The onset is insidious, the patient first noticing swelling around a joint, which may show limitation of active movement and slight local tenderness. Severe systemic disturbances such as are seen in acute pyogenic arthritis and classical acute osteomyelitis are not seen initially. Swelling of the soft tissues overlying the affected bones and joints may be marked.

The authors feel that this entity is due to infection of the bone by the virus of smallpox rather than a pyogenic osteomyelitis. Their reasons for this theory are presented.

The most noteworthy lesion specific to this virus infection is a metaphysitis, causing growth disturbances which may result in bizarre deformities as the child gets older. In the acute stage the initial film will show the soft-tissue swelling and joint effusion. Careful inspection will usually disclose early juxtametaphysial osteoporosis of one or more of the bones making up the joint, and perhaps a very thin layer of periosteal new bone. Within ten days the metaphysitis is evident as a definite transverse band of bone destruction. Periosteal new bone is now becoming obvious and this becomes most exuberant in several days. The periosteal "involucrum" surrounds the affected shaft along its length but is usually limited above and below by the capsular attachments, where a spur can be seen for a short time within the second and third weeks of the disease. By the third and fourth weeks the original diaphysis may appear to be sequestrated within the "involucrum." This was a familiar finding in the past in untreated pyogenic osteomyelitis, but here the original diaphysis does not behave as dead bone to be extruded. Instead it gradually becomes assimilated to merge with the investing periosteal "involucrum." Considerable remolding occurs within a year, so that the shaft of the bone can no longer be separated from the investing bone. However, most bones severely involved will remain thicker than normal.

In carpal and tarsal bones patchy destruction is evident at first and is followed by repair, with sclerosis and some periosteal new bone. The bone remains expanded and of increased density for at least a year.

A proportion of the affected bones and joints become restored to normal. In most instances, however, joint function and bone growth are affected. Late changes may include a flail joint, with or without loose bodies, bony or fibrous ankylosis, degenerative secondary arthritis, and malformed bones, but apparently intact joint space. Growth disturbances consist in total cessation of growth (rare), retardation of growth with expansion of metaphyses and delay in appearance or disappearance of the secondary centers of epiphyseal ossification, premature obliteration of epiphyseal lines, and distortion by weight-bearing.

Fifteen roentgenograms; 3 photographs.
THEODORE E. KEATS, M.D.
University of Missouri

Bone Involvement in Synovial Sarcoma. Basil Strickland and D. H. Mackenzie. J. Fac. Radiologists **10:** 64–72, April 1959. (Westminster Hospital, London, S. W. 1, England)

The authors describe their experience with bone involvement in synovial sarcoma, based upon 18 cases. These were chosen from a total series of 65 synovial sarcomas.

The diagnosis of synovial sarcoma should be suspected when a soft-tissue tumor is associated with pressure atrophy of adjacent bones, particularly when the bones show a periosteal reaction or evidence of erosion. The dominant radiological feature in 7 of the authors'

cases was periosteal proliferation. In most instances this was of the "layer" type but sometimes the proliferation was irregular and haphazard. Osteolytic lesions were also observed, usually as a progressive disappearance of the shaft of a bone previously made atrophic from pressure. More rarely, there was a central osteolytic nidus alone, or an erosion commencing at the attachment sites of a joint capsule. Infrequently involvement may be manifested as osteosclerosis of the medulla and cortex together with periosteal proliferation. The joint is not often involved. Soft-tissue calcification, although useful in diagnosis, is too infrequent to be of great value.

Bone involvement in synovial sarcoma may represent extension of the primary tumor or may be metastatic. In one of the cases reported there was widespread involvement of the skeleton secondary to a synovial sarcoma of the soft tissues of the right forearm.

Eighteen roentgenograms; 6 photographs.

THEODORE E. KEATS, M.D.
University of Missouri

Chronic Neurological Sequelae of Acute Trauma to the Spine and Spinal Cord. Part II. The Syndrome of Chronic Anterior Spinal Cord Injury or Compression. Herniated Intervertebral Discs. Richard C. Schneider. J. Bone & Joint Surg. **41-A:** 449–456, April 1959. (University of Michigan Hospital, Ann Arbor, Mich.)

Patients with acute or chronic recurrent traumatic lesions of the spine and spinal cord may recover initially, but neurologic sequelae may develop years later. At that time a diagnosis of degenerative disease, neoplasm, an inflammatory condition of the central nervous system, or cord compression due to hypertrophic arthritis may be made erroneously. Efforts should therefore be directed toward obtaining a complete history. In an earlier paper, the author considered the significance of acute flexion or "tear-drop" fracture-dislocations of the cervical spine in this connection (Schneider and Kahn: J. Bone & Joint Surg. **38-A:** 985, 1956. Abst. in Radiology **69:** 775, 1957). Here the problems associated with chronic sequelae of disk herniation are considered.

Four cases of ruptured cervical intervertebral disk are presented which, following a single traumatic episode or multiple recurrent injuries, showed symptoms and signs of the chronic anterior cervical spinal-cord injury or compression syndrome. This syndrome is characterized by gradually progressive weakness and spasticity with hyperreflexia in the lower extremities and extensor plantar reflexes without significant sensory changes initially. In all 4 cases there was evidence of the lesion on the cervical myelograms. Myelography should preferably include also the lumbar area.

Seven roentgenograms.

J. S. ARAJ, M.D.
Toledo, Ohio

Dislocations of the Shoulder with Special Reference to Accompanying Small Fractures. Richard H. Hall, Frank Isaac, and Charles R. Booth. J. Bone & Joint Surg. **41-A:** 489–494, April 1959. (VA Hospital, Long Beach, Calif.)

Defects of the head and neck of the humerus related to dislocation of the shoulder are being overlooked by many surgeons for at least three reasons. The defects are not demonstrated on conventional routine roentgenograms, they are not readily exposed by usual anterior surgical approaches, and their clinical significance has been minimized. The authors review the soft-tissue, cartilaginous, and bone injuries which are associated with shoulder dislocation and briefly mention the mode of therapy.

Because demonstration of an avulsion fracture of the anatomical neck of the humerus seems important, both in the treatment of acute dislocations to help prevent recurrence and in the planning of surgical treatment, it is desirable to visualize this roentgenologically. Since routine anteroposterior views seldom, if ever, show this area, the authors have adopted a new position giving what they call a "notch" view. The patient is placed in the supine position with the hand over the head. The long axis of the arm must be parallel with the sagittal plane of the body. The x-ray tube is tilted 10° cephalad and the central beam enters the coracoid process area. The film thus obtained demonstrates in profile the posterosuperior and anteroinferior regions of the articular surface and anatomical neck of the humerus.

Notch views of 20 patients with recurrent dislocation showed defects on the posterior surface of the humeral head in 18, all later confirmed by surgery. Small fractures were also seen in 3 patients with acute anterior dislocation. The authors recommend such a view in all acute and recurrent shoulder dislocations.

Six roentgenograms; 2 photographs; 7 diagrams.

J. S. ARAJ, M.D.
Toledo, Ohio

Pathogenic Variation of the Ossification of Multiple Phalangeal Epiphyses. Gerd Schröder. Radiol. clin. **28:** 111–116, March 1959. (In German) (Noldnerstr. 40–42, Berlin-Lichtenberg, Germany)

Normal undisturbed epiphyseal ossification plays an important role in the development of the body and in the function of the joints. Disturbances in this process are attributable to hormonal disregulation, hereditary constitutional factors, and micro- and macrotrauma. Many authors believe that multiple related factors are involved.

The author calls attention to an atypical thickening of the epiphyses of the distal phalanges of the hand, which has been called by Staples (J. Bone & Joint Surg. **25:** 917, 1943) osteochondritis. Some of the epiphyses are so rich in calcium that they resemble "marble bones"; in the remainder of the hand the calcium content is normal. The condition is asymptomatic, without pain or swelling, and function is unimpaired. Re-examination after two years in a case reported by Brailsford (Radiology of Bones and Joints, London, 1948) showed the epiphyses to be normally united with disappearance of the atypical density.

The author himself reports a case in a boy of thirteen. In his opinion the changes are due neither to osteochondritis nor other bone pathology. He agrees with Brailsford in regarding the condition as merely a variation of normal ossification.

Two roentgenograms.

ILONA D. SCOTT, M.D.
Lewisburg, W. Va.

Peritendinitis Calcarea with Special Reference to the Hand. E. R. Hitchcock and L. Langton. J. Fac. Radiologists **10:** 86–94, April 1959. (L. L., United Birmingham Hospitals, Birmingham, England)

The authors present here 6 cases of peritendinitis

calcarea in the hand. Numerous reports of its occurrence elsewhere are cited.

The outstanding clinical features of peritendinitis calcarea are pain, tenderness, and limitation of movement. While the condition can be strongly suspected on clinical grounds, radiographic examination is necessary to establish the diagnosis by demonstrating localized extra-articular calcium deposition in the soft tissues in the region of the joint. The disease in the acute phase is self-limiting, lasting usually no longer than two or three weeks. A striking feature is the spontaneous absorption of the calcium deposit, though its full disappearance occurs more slowly. Chronic and latent forms exist, but acute symptoms develop eventually in many such cases.

The calcium deposit is always located in the region of a joint, though it may vary in density.

There is variation, also, in size and shape, some deposits being rounded and others having linear components suggesting their probable location in collateral ligaments or in tendinomuscular junctions of small muscles of the hand. Diminution in size appears rapidly during the course of treatment, as mentioned above; subsequently fragmentation occurs, and the deposit gradually disappears.

There seems to be little doubt that the condition in the hand is identical with that which has been reported at the shoulder and in other sites. Most authors accept the view that the calcification follows local tissue necrosis. Many and variable treatments have been put forward. The authors advocate conservative management in the form of a plaster-of-Paris splint.

Sixteen roentgenograms.

THEODORE E. KEATS, M.D.
University of Missouri

GYNECOLOGY AND OBSTETRICS

Diagnostic Value of Pelvic Arteriography in Tubal Pregnancy. Hüsnü Özaras. Acta radiol. **51:** 257–265, April 1959. (Karolinska Sjukhuset, Stockholm, Sweden)

It has been found by others that the arteriographic appearances make possible a diagnosis of tubal pregnancy if the placental sinuses communicate with the adnexal branches of the uterine artery and also if the placental sinuses contain circulating blood.

In the present series of 37 cases of tubal pregnancy, 26 could be diagnosed by arteriography. The adnexal branch of the uterine artery on the side of the affected tube generally showed the following characteristics: (1) widened caliber (1 mm. or more); (2) division into several branches, some of which were arched. Similar appearances may be found, however, in salpingitis or ovarian tumor. The demonstration of placental sinuses outside the uterus is definitely diagnostic.

The corpus luteum of pregnancy may occasionally be visible outside the uterus in a pregnancy of fifty to seventy days duration and may be confused with an ectopic pregnancy. The corpus luteum, however, is round or oval in shape, with a regular outline, whereas the placenta in ectopic pregnancy has an irregular outline and fills unevenly.

In 2 cases, it could not be determined with certainty whether the placental sinuses demonstrated were within or outside the uterus.

Three or four films were taken in each case (in the anteroposterior projection), and the dose to the fetal gonads and maternal ovaries was calculated and found to vary between 0.3 and 0.6 r.

Eight roentgenograms.

MAJ. BYRON G. BROGDON, M.D.
Lackland AFB, Texas

Roentgenographic Visualization of Lymph Nodes and Lymphatic Channels. Harry W. Fischer and George R. Zimmerman. Am. J. Roentgenol. **81:** 517–534, March 1959. (State University of Iowa School of Medicine, Iowa City, Iowa)

By extensive and careful experimental work, the authors undertook to determine the accuracy of lymphography for the demonstration of abnormalities in lymph nodes and channels.

Abnormal conditions were produced artificially in a lymph node or the lymph vessels in the dog. For example, to simulate a metastasis, a small polyethylene sphere was introduced surgically into a node. This was beautifully demonstrated as a filling defect by contrast visualization. A sterile abscess produced by electrocauterization could be demonstrated equally well. Lymph vessels were ligated and the obstruction was clearly shown by lymphography.

With great objectivity the authors discuss the pros and cons of the method. Apparently lymph trunks and nodes are rather simply arranged in the dog but are more complicated in man. Also cannulation of the lymph trunks is more difficult in man. They seem smaller and more fragile and more likely to go into spasm upon manipulation.

Many different media were tested, and their advantages and disadvantages are discussed. The amounts needed for demonstration of disease were carefully investigated. Too little contrast material within a node may be a source of misinterpretation. On the other hand, too much has a tendency to obscure a possible lesion.

The authors are quite aware that the method so far is entirely experimental, but hope is expressed that in time it will achieve practical status.

Nineteen roentgenograms.

MAX EICHWALD, M.D.
Encino Hospital, Encino, Calif.

A Viscous Solution of Sodium Acetrizoate as a Medium for Hysterosalpingography. J. Hillyer Smitham. Brit. J. Radiol. **32:** 193–197, March 1959. (Chelsea Hospital for Women, London, S. W. 3, England)

The various substances which have been used to add viscosity to aqueous solutions adapted for hysterosalpingography have been unsuitable. Carboxymethylcellulose and several of the polymers fall into this group. The author, therefore, has chosen Dextran as the colloid, adding it to sodium acetrizoate to produce a solution containing 40 per cent of the latter substance. The resulting viscous solution will contain 26.4 per cent iodine. The Dextran is noncarcinogenic and is completely eliminated by the body.

Eighty-five patients were examined with this medium, 8 to 15 c.c. being injected with a Rubin-type cannula under fluoroscopic control. Spot roentgenograms were made as the solution filled the uterine cavity and spilled into the peritoneum. After removal of the cannula, a roentgenogram was obtained in a prone position. Turning the patient into this position helped distribute the medium in the peritoneum and the pattern of dis-

tribution gave additional information for interpretation. In normal cases the medium was absorbed within fifty to sixty minutes, thus allowing ample time to obtain follow-up studies where hydrosalpinx was present. (With noncolloidal aqueous iodized solution, absorption is often too rapid for filling of the hydrosalpinx completely.)

No premedication was given to these patients. The main side-effect was pain occurring when the medium reached the tubes (relieved by amyl nitrite) and when the solution entered the peritoneum. Of the 85 patients, 52 said they had no pain at all. In most of the remaining patients the discomfort reported was slight.

Nine roentgenograms.

DAVID D. ROSENFELD, M.D.
Fontana, Calif.

THE GENITOURINARY SYSTEM

Angionephrographic Effect in Renal Damage. An Experimental Study in Dogs. N. P. G. Edling and C. G. Helander. Acta radiol. **51**: 241–246, April 1959. (Karolinska Sjukhuset, Stockholm, Sweden)

The normal nephrographic effect in renal angiography depends upon the accumulation of contrast medium in the tubular cells and ducts and back diffusion in the veins from these cells. In experimental studies of canine kidneys intentionally damaged at angiography, the angionephrographic effect may deviate from normal. The present study is based upon selective renal angiographies with abnormal angionephrographic effect in 11 healthy dogs.

All but one kidney showed marked changes in the accumulation of contrast medium compared with the normal angionephrographic effect. All of these were found to have histologic evidence of severe renal damage. In three studied by selective clearances, functional disturbances appeared after injection of contrast medium. [This may be a result of the catheter being in the renal artery.—H. W. K.]

The retention of the contrast medium in the renal artery and vein and their branches a long time after the end of the injection suggests that the intrarenal circulation is impeded. The fact that the control medium accumulates irregularly in the cortex, and anywhere in the medulla, for some minutes, without passing to the papilla for emptying into the pelvis, indicates that it remains in the vessels and tissues instead of being excreted into the tubules. These findings suggest that the blood pressure in the glomeruli is too low for filtration and that the blood flow is so reduced that the tubular cells are unable to function.

The abnormal findings were not correlated with the dosage of contrast medium. This observation suggests that the abnormality is a result of reflex influence of the medium rather than a direct cellular effect. The changes noted in this study indicate that the abnormal angionephrographic effect results from vascular and tissue retention of contrast medium secondary to alterations in circulation. This differs from the normal angiographic effect which is primarily due to accumulation of contrast media in the excretory system.

Six roentgenograms.

CAPT. HARRIS W. KNUDSON, M.C.
Lackland AFB, Texas

MISCELLANEOUS

Budd-Chiari's Syndrome Diagnosed by Means of Phlebography in a Case of a Retroperitoneal Sarcoma. Maj Levander and Jan Pontén. Acta med. scandinav. **163**: 251–255, 1959. (Karolinska Sjukhuset, Stockholm, Sweden)

A case of Budd-Chiari's syndrome in a 53-year-old woman is reported. The clinical picture of abdominal pain, enlargement of the liver with signs of slight parenchymal damage and jaundice, ascites, and edema of the feet was typical of the syndrome. The patient also complained of dyspnea, which diminished on lying down; this type of dyspnea has been described in tumor of the right auricle. Phlebography of the inferior vena cava disclosed an absolute obstruction to the passage of the catheter at the level of the diaphragm; below this there was a segment of partial obstruction of the inferior vena cava 7 to 8 cm. long. There was a rich anastomotic net around the vertebral column. The right anterior aspect of the inferior vena cava was somewhat angled in its course at the level of the hilus, signifying a deformation caused by an expansive process. A diagnosis of Budd-Chiari's syndrome was made, with the occlusion probably the result of a neoplasm.

Postmortem examination revealed a retroperitoneal sarcoma which had grown into the lumen of the inferior vena cava, almost completely occluding it. The tumor also filled a considerable part of the right auricle and bulged downward into the orifice of the tricuspid valve, which explained the unusual type of dyspnea which this patient experienced.

Two roentgenograms; 3 photomicrographs.

TECHNIC

Roentgen-Television Equipment for Use in Surgery. Henry Wallman and Ingmar Wickbom. Acta radiol. **51**: 297–304, April 1959. (Chalmers University of Technology, Gothenburg, Sweden)

This paper reports "work in progress" on developing roentgen-television equipment suitable for use in the operating room. Described is a roentgen-television system with image intensifier and vidicon camera as well as a roentgen-television system with an image storage tube. The equipment has so far been employed only in the laboratory; however, clinical use is contemplated.

The need for rapid information in operative cases is pointed out. Speed is even more important than fine detail, for example, when one is dealing with fracture reduction. Use of the television picture tube removes the operator from the radiation zone; brightness of the screen permits viewing in the lighted room, and the large screen (as contrasted to image amplifiers) enables more than one person to examine the case. With this system as presently developed, the quality of the image is considered adequate for reduction of fractures and nailing.

The roentgen-television system with an image storage tube not only provides an immediately available image but reduces patient exposure while enabling longer or intermittent viewing. A number of storage (or memory) tubes are now available, although this field is far from fully developed. The authors found that by adding such a tube to their roentgen-television system,

an image was obtained that persists for about sixty seconds. Quality is adequate for fracture reduction and fixation. By intermittent use (pulsing) of the charged "memory" screen in the tube, a useful image is available for three minutes after a single x-ray exposure. The roentgen dose to the examiner is zero and the dose to the patient is very small.

Six figures, including 4 roentgenograms.

MAJ. NEIL E. CROW, M.C.
Lackland AFB, Texas

Readily Available Bucky for Use in Surgery. James D. Colt. Arch. Surg. **78**: 550, April 1959. (1705 27th St., Bakersfield, Calif.)

By removing the top and a few bolts from the genitourinary operating table the author found that the Bucky could be made available for use in other operating rooms in cases requiring the use of x-rays where good detail was essential.

One photograph.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

RADIOTHERAPY

Comparison of Medium Voltage and Supervoltage Roentgen Therapy in the Treatment of Oropharynx Cancers. Gilbert H. Fletcher, William S. MacComb, Paul M. Chau, and Wesley G. Farnsley. Am. J. Roentgenol. **81**: 375–401, March 1959. (M. D. Anderson Hospital and Tumor Institute, Houston, Texas)

For determining the clinical effectiveness of supervoltage *vs.* conventional 250-kv therapy, the authors chose to use the more advanced tumors of the oropharyngeal region, which cannot be covered by intraoral cones or interstitial implants. Staging was on the basis of tumor size, local extension, and metastases. The anatomic sites were: (1) the retromolar trigone and anterior faucial pillars, (2) soft palate, (3) tonsils, (4) pharyngeal walls, (5) base of tongue and glossopalatine sulcus. (These last two are grouped together as the tumors of the glossopalatine sulcus were not numerous enough for separate analysis.)

Classification is well detailed, but the distribution of cases in various stages is not equal. These variations in distribution are recognized in the authors' analysis of the series. They do not lend themselves to abstracting, however, and must be obtained from the original paper. It is implicit that the orthovoltage cases are from the presupervoltage period and that, although not so stated directly, supervoltage is the more common radiation modality at the present time.

Supervoltage Technic: Single ports were used, or two opposed ports with equal or unequal doses. Port size and tumor dose depended on individual situations. The range was from 50 to 100 sq. cm. and from 6,000 to 7,500 r in four to six weeks for most cases. Selected cases received radical neck dissection. For palliation and in the elderly the dose of choice for Co^{60} is considered to be 6,000 r in six weeks. In roentgens (not rads) Co^{60} and the 22-Mev betatron were without differences in producing local radiation reaction. It is the authors' opinion that doses of 6,000 r in six to seven weeks are in the lower range of tumor control.

Because interim disease may result in death, especially in the elderly, analysis of results was based on control of primary disease, neck metastases, and survival at one, two, and three years only. Results are well tabulated, though there appears to be an omission in accounting the results of treatment of one small soft-palate lesion with a single small neck node in the orthovoltage group.

The series comprised 21 cases with soft-palate lesions treated by orthovoltage and 33 with supervoltage; 58 cases of oropharyngeal lesions treated with orthovoltage and 74 with supervoltage.

Results: The results, grouped according to anatomic sites, are as follows:

Palatine arch: Statistical conclusion is not possible, but the authors feel that supervoltage irradiation controls the primary lesion more effectively except in early tumors which can be covered by intraoral treatment.

Retromolar trigone and anterior faucial pillars: There were more favorable cases and fewer advanced lesions in the orthovoltage group. Equally good results were obtained by the two modalities with the early lesions. Recurrences were approximately the same in both groups. Few advanced lesions were treated by orthovoltage, but the authors believe that if intraoral treatment or radium cannot be used supravoltage is to be preferred.

Tonsils: Cases in the orthovoltage group were less advanced, but better control was nevertheless secured by supervoltage.

Base of Tongue: The two groups are comparable. Local control is increased with supervoltage. In the unfavorable cases there were a greater number of survivals at one year but this tended to equalize in three years.

Pharyngeal walls: Primary control with supervoltage was much better despite the fact that there were more advanced cases in this group. Again, with the advanced lesions the number of survivors was greater in the supervoltage group initially, but the difference narrowed considerably at three years.

Due to better control of the primary lesion, more cases of death due to distant metastases occurred in the supervoltage group.

Thirteen figures; 6 tables.

VAHE MEGHROUNI, M.D.
Los Angeles, Calif.

Carcinoma of the Base of the Tongue. Victor A. Marcial. Am. J. Roentgenol. **81**: 420–429, March 1959. (Oncologic Hospital, San Juan, Puerto Rico)

In Puerto Rico carcinoma involving the base of the tongue is very common. The author reviews 240 cases, giving careful attention to the incidence, age and sex distribution, etiology, pathology, symptoms, extension, metastases, etc.

In over 50 per cent of the cases there was a history of cigar smoking and tobacco chewing. In 11 per cent alcohol intake was mentioned; another 11 per cent were serologically positive for syphilis.

Most cases were treated with orthovoltage x-ray therapy (h.v.l. 2.0 mm. Cu). Lateral opposing and submental fields were used and a tumor dose of 3,500 to 5,000 r was given in three to seven weeks. In some

cases supplementary radium implantation was done for residual induration in the base of the tongue. During the last two years Co^{60} teletherapy was used and treatments were given only through lateral opposing fields. In six to seven weeks a tumor dose of 6,500 r was delivered. The author believes that supervoltage therapy is the method of choice, since results are more satisfactory and the treatments are better tolerated.

Of the author's series, 135 patients were seen five years ago or longer. Of these, 36 received no therapy or palliative treatment only. Eleven patients survived five years, giving a net survival rate of 11.1 per cent and an absolute survival rate of 8.1 per cent. Of the 11 five-year survivals, 1 was treated with surgery only, another with surgery following radium, and 9 cases received orthovoltage roentgen therapy. One patient is alive fourteen years after roentgen therapy for both the primary disease and histologically proved cervical metastases.

Two roentgenograms; 2 photographs; 2 graphs; 8 tables.

MAX EICHWALD, M.D.
Encino Hospital, Encino, Calif.

Method for Irradiation of Parasternal Lymph-Node Metastases. F. Edsmyr and R. Walstam. Acta radiol. **51**: 308–320, April 1959. (Radiumhemmet, Stockholm, Sweden)

Several clinical investigators have shown that the probability of parasternal metastases is greater if the primary tumor is located in the medial or central part of the breast. Most of the metastases are found in the second to fourth intercostal spaces. The nodes lie 3 to 4 cm. deep in the supraclavicular fossa but only about 2 cm. in the third and fourth intercostal spaces.

At the Radiumhemmet, from which this report comes, treatment of the parasternal nodes with conventional roentgen irradiation to a skin dose of 3,000 r in fourteen days has often resulted in severe skin and lung reactions. A 5-gm. radium unit, used for a year, had the advantage of decreasing the selective bone absorption, reducing dosage to the lung, and improving skin tolerance. However, the diffuse radiation beam of radium results in inhomogeneities of dose distribution within the treatment area and a dose volume larger than needed.

In an attempt to eliminate these objections a decacurie Co^{60} apparatus was designed and put to use in 1955. A first series comprising 38 patients was treated with this apparatus, with the ordinary treatment tubes. The distance between the cobalt source and the skin was 10 cm., and the width of the treatment area at the skin surface was about 6 cm.; at a depth of 10 cm. the width was 12 cm. With an extrapolated skin dose of about 4,500 r the radiation dose was about 3,700 r at 3 cm. depth and about 2,000 r at 10 cm. In order to adapt the dose distribution better to clinical requirements, a special parasternal tube has since been designed, based upon the observations on the position of the chain of nodes mentioned above: 3.5 cm. was chosen as the width of the area at the surface and 6 cm. for the source-skin distance. It has been necessary to limit the length of the treatment area to about 6 cm. but the well defined radiation beam is divergent in the longitudinal axis of the area. In order to obtain even dosage distribution an overlapping field technic was used. An excellent description of the tube and technic is given.

The group receiving irradiation of the parasternal region by these two methods was comprised of patients with medial or central primary tumors, or lateral primary tumors with axillary metastases. The probability of parasternal metastases in this group is more than 50 per cent.

No estimate of results can be made at this early date. The skin reactions were mild in the majority of the patients. No serious complications locally or systemically were encountered.

Nine figures, including 2 roentgenograms; 4 tables.

CAPT. HARRIS W. KNUDSON, M.C.
Lackland AFB, Texas

The Treatment of Polycythæmia Vera by Irradiation: A Follow-Up Study of 52 Cases. H. David Friedberg. J. Fac. Radiologists **10**: 77–79, April 1959. (Christie Hospital and Holt Radium Institute, Manchester 20, England)

This is an analysis of 52 cases of polycythemia vera treated by irradiation at the Christie Hospital and Holt Radium Institute between January 1944 and June 1956.

In the earlier part of the series (17 patients) treatment was by whole-body irradiation with 250 kv apparatus, as described by Paterson (The Treatment of Malignant Disease by Radium and X-Rays, 1948). Irradiation of the spleen was tried in 7 patients but results were unsatisfactory. Since 1949, 28 patients have been treated with P^{32}. At first the patient received two or three injections of 3 to 5 mc, with intervals of a few months between injections. At present, a single injection of 100 to 400 μc per kilo of body weight is given. Preliminary venesection is only occasionally done.

The results of whole-body x-irradiation and radiophosphorus are strikingly similar. About two-thirds of patients had a complete remission; one-sixth showed partial improvement and one-sixth no improvement. It was not possible to forecast which patient would have a remission, nor could the duration of remission be correlated with any clinical data. Follow-up was from eighteen months to fourteen years. The corrected five- and ten-year survival rates were 84.5 and 57.5 per cent respectively.

Following whole-body x-irradiation, 3 patients had anemia and agranulocytosis. One died and 2 recovered. The given doses were 312, 200, and 228 r respectively. The commonest dose was from 150 to 175 r in twenty to twenty-four days. One patient died four days after receiving 5 mc P^{32}, from depletion of the bone marrow. He had had two previous courses of triethylene melamine.

Temporary relief in polycythemia vera is afforded by venesection, phenylhydrazine, or pyrimethamine, but only irradiation—whole-body x-irradiation or radiophosphorus—produces a remission.

One chart; 8 tables.

EUGENE A. CORNELIUS, M.D.
Houston, Texas

Treatment of Terminal Leukemic Relapse by Total-Body Irradiation and Intravenous Infusion of Stored Autologous Bone Marrow Obtained During Remission. Joseph J. McGovern, Jr., Paul S. Russell, Leonard Atkins, and Edward W. Webster. New England J. Med. **260**: 675–683, April 2, 1959. (Harvard Medical School, Boston, Mass.)

The authors describe 3 cases of acute lymphoblastic

leukemia in terminal relapse which were treated with 570–600 r total-body irradiation followed by infusion of autologous bone marrow that had been obtained during remission and stored in 15 per cent glycerol at −70°C. The bone marrow was removed from both iliac bones by multiple aspirations under general anesthesia, with strict aseptic precautions.

X-ray therapy was given with a 2-million-volt Van de Graaff machine at a distance of about 2.5 meters from the midplane of the patient. Multiple portals were used. The total body dosage was 570 to 600 rads, which is double the probable LD 50 for man.

One patient died nine days after irradiation, with leukemia still present, and another died twenty-three days after irradiation, with no evidence of leukemia or repopulation of the bone marrow. A third case showed recovery of normal marrow within seventeen days, with a clinical and hematologic remission, and the rapidity of the recovery of normal bone marrow and peripheral blood after radiation exposure in the potentially lethal range suggests that the attempted marrow autograft was successful.

Five photomicrographs; 5 tables.

PAUL MASSIK, M.D.
Quincy, Mass.

Therapy of Acute Leukemia by Whole-Body Irradiation and Bone Marrow Transplantation from an Identical Normal Twin. John B. Atkinson, Francis J. Mahoney, Irving R. Schwartz, and Joseph A. Hesch. Blood **14:** 228–234, March 1959. (Fitzgerald Mercy Hospital, Darby, Penna.)

This is a report of a case of acute leukemia in a child of eighteen months treated by total body irradiation followed by bone marrow transplantation from a normal identical twin. The patient received 255 tissue roentgens. The following morning, under general anesthesia, bone marrow was obtained from the normal twin. A total of 31 aspirations was done, with an average volume of 1.3 c.c. and a total volume of 40.3 c.c. Each bone marrow aspirate was withdrawn into a siliconized syringe containing 1.0 c.c. of an anticoagulant and immediately and separately given to the leukemic twin through a polyethylene cannulated anterior tibial vein. The response was good and within a week the patient was active and ambulatory on the pediatric floor.

In this patient the dose of irradiation given is believed to have been adequate to destroy all leukemic cells or prevent their recurrence. While isologous marrow was used for transplantation, animal experimentation would indicate that possibly a better control of leukemia may be obtained from the use of homologous marrow.

Twenty per cent to 30 per cent temporary depilation occurred within twenty-one days after irradiation. There were no changes in the skin or mucous membranes and, except for vomiting during the first seventeen hours, there were no gastrointestinal symptoms. There were no changes in the lenses or corneae of the eyes. While the level of irreparable damage to vital organs may be a sharp and critical amount, it would appear to be well above 255 tissue roentgens, and higher doses should probably be used in the future, with protection possibly afforded by marrow transplantation.

Two figures; 2 tables.

WYNTON H. CARROLL, M.D.
Shreveport, La.

The Place of Radiotherapy in the Treatment of Diseases of the Skin: Benign Conditions. Eric H. Taft. M. J. Australia **1:** 454–456, April 4, 1959. (Melbourne, Australia)

The article is a very general and fundamental one. The various dermatological entities for which radiotherapy has proved beneficial are listed and a short comment about the efficacy of radiotherapy is given. No specific technics are presented. It is concluded that the use of radiant energy in therapy of skin diseases must be governed by the knowledge, experience, and clinical judgment of the dermatologist, and that such treatment is a potent and simple remedy for many skin diseases.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

The Place of Radiotherapy in the Treatment of Diseases of the Skin: Malignant Conditions. D. M. Clarke. M. J. Australia **1:** 456–458, April 4, 1959. (Melbourne, Australia)

The author lists a large number of premalignant and malignant skin diseases which may be successfully treated or cured by radiotherapy. General comments are made relative to each disease, but no specific radiotherapeutic technics are presented. The range of useful radiation qualities is a wide one, varying from the supersoft beryllium window or grenz rays up to the filtered rays of radium or even the linear accelerator. The author refuses to enter into the controversy as to whether surgical excision or radiotherapy should be chosen for a specific malignant skin disease. He prefers to base his choice of the mode of therapy on socio-economic factors as well as the usual individualization regarding medical indications.

Both papers are useful for one desiring basic or fundamental knowledge in radiotherapy for dermatologic problems.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Contribution to the Clinical Study, Diagnosis and Therapy of Melanosis Circumscripta Preblastomatosa. Hugo-Constantin Friederich, Siegmund Limberger, and Wolfgang Nikolowski. Strahlentherapie **108:** 361–370, March 1959. (In German) (Universitäts-Hautklinik, Tübingen, Germany)

Melanosis circumscripta preblastomatosa is best known to dermatologists as a separate clinical entity. From a histologic standpoint, however, the condition is not entirely clarified. It gradually develops from a pigmented nevus through increase in size and change in color. The lesion is usually first observed by the patient because of an itching sensation.

Prompt recognition of the disorder is important, since 25 per cent of melanomas can be traced to a melanosis circumscripta, while 75 per cent of cases of the disease are said to develop into alveolar melanoma, this type being more malignant than the fascicular form. Usual sites are the face, temples, neck, trunk, extremities, scalp, and mucosa. The condition is more prevalent in females.

Diagnosis can be established when a nevus pigmentosus gradually enlarges during a period of months or years. Irregular and unevenly arcuate border lines are formed; also infiltration is noted, together with a change of color, alternating between light and dark brown and bluish black.

There is need for radical therapeutic measures as soon as the diagnosis has been established. Superficial

grenz-ray therapy is inadequate, as the lesions usually extend into the subcutaneous layers and hair follicles. Ordinary roentgen therapy is likewise ineffective, because of marked radioresistance of the pigmented cells. Electron-beam therapy, however, is indicated in less accessible areas, such as gingival tissue around the teeth. In most locations radical surgical excision is the treatment of choice. The resulting defect has to be covered by skin transplants in many instances.

Six representative cases are briefly reported and illustrated, and the histopathology is discussed.

Nine photomicrographs; 5 photographs.

ERNEST KRAFT, M.D.
Northport, N. Y.

Cystic Hygroma. Frederick W. Fuller and Herbert Conway. Surg., Gynec. & Obst. **108:** 457–462, April 1959. (New York Hospital-Cornell Medical Center, New York, N. Y.)

Cystic hygroma is a multiloculated, fluid-filled lesion, derived from lymphatics, occurring most often in infancy and located most commonly in the neck and axilla. Less often it is seen in the shoulder, pectoral region, posterior chest wall, and cheek and tongue. Rarely, it may be located in the retroperitoneal space or mediastinum. Histologically, hygromas are cystic lymphangiomas.

Twenty-five cystic hygromas were seen at the New York Hospital-Cornell Medical Center, New York, from 1932 through March 1958. Sixteen (64 per cent) were in females and 9 (36 per cent) in males. Eleven (44 per cent) were discovered at birth, and an additional 4 (16 per cent) by the age of five years. Four more were discovered prior to the age of twenty years. Six (24 per cent) had their onset later. In 3 cases an upper respiratory infection preceded a sudden enlargement of the mass.

The tumors are soft and lobulated, with indistinct borders and no attachment to the overlying skin. Depending upon the location, there may be pain, hyperesthesia, or paralysis secondary to brachial plexus involvement. Distortion of the floor of the mouth or lateral wall of the pharynx may be seen.

In this series surgical removal was the primary treatment. Postoperative fluid reaccumulations were common because of the inability to remove all of the ramifications of the tumor. The majority of these subsided after repeated aspirations. Tracheostomy is recommended when there is any threat to the respiratory passage.

There were 3 cases in which radiation was employed either as a primary agent prior to admission or secondarily to control recurrences after surgery. No effect was observed in 2 cases (dosage not stated). There was life-saving relief of symptoms in one infant of thirteen months, previously moribund from obstruction of the pharyngeal and tracheal areas from a recurrent cervical hygroma. A dose of 600 r (factors unstated) caused prompt local relief of swelling, but not cure.

Seven photographs. MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

A Case of Klippel-Trenaunay Syndrome Successfully Treated with Roentgen Therapy. Martins da Silva and Hermano Neves. Fortschr. a. d. Geb. d. Röntgenstrahlen **90:** 475–482, April 1959. (In German) (Hospital de Curry Cabral, Lisbon, Portugal)

The authors describe a case of the Klippel-Trenaunay syndrome with associated soft-tissue hypertrophy and bone hyperplasia. The changes manifested themselves as demineralization of the bones with increased spacings between the trabeculae. There were also an anomaly of the elbow joint and multiple phleboliths of the soft tissues. This case was successfully treated with roentgen therapy and the soft-tissue hypertrophy was reduced. According to the authors this is the third case of this syndrome in the world literature in which x-ray therapy was used.

It has been proposed that the name vascular osseous dysembryoplasia be used to include all diseases of the blood vessels with or without changes in the bones, thus bringing together the different hemangiomas as well as the Klippel-Trenaunay syndrome in its typical or atypical form.

Five roentgenograms; 2 photomicrographs; 2 photographs; 3 tables. ILONA D. SCOTT, M.D.
Lewisburg, W. Va.

Lymphangiosarcoma Occurring in Association with Lymphœdema. H. F. Hope-Stone and E. A. Bence. J. Fac. Radiologists **10:** 73–76, April 1959. (London Hospital, London, England)

Thirty-five cases of lymphangiosarcoma occurring in an edematous limb have been reported previously. Two additional cases, in edematous arms after radical mastectomy, are presented. The 37 cases are reviewed in detail.

Lymphedema is the obvious etiologic factor. In 32 cases the edema followed radical mastectomy, in 1 case simple mastectomy, and in 1 case operation on a fractured femur. In 3 cases the edema was spontaneous. Radiotherapy had been carried out in only 19 of the 37 cases, excluding irradiation as a direct etiologic agent. How the lymphedema may cause a subsequent malignant process is not known. Possibly a benign proliferation of lymphatic vessels, to cope with the excessive fluid, may get out of hand.

The mean average age at which the tumor first appeared was fifty-two years. Moderate or marked edema of the limb was present in every case. Its average duration before the tumor occurred was nine and a half years. Pain was usually severe only in the late stages.

The first sign of the tumor may be either an area of indurated bluish-yellow skin or purplish-red subdermal nodules. In both types, only the skin, subcutaneous fat, and superficial fascia were involved, there being no deep extension of the tumor. In post-mastectomy cases, the region of the elbow joint was the most common initial site. Metastases occur to lungs, liver, lymph nodes, and bones. Average survival after diagnosis was nine months.

Microscopically there is a malignant proliferation of thin-walled vessels lined by crowded epithelial cells, both normal and neoplastic in nature. Early invasion of veins is a common feature. The diagnosis can be made only by open biopsy.

The patient dies from pulmonary or liver metastases. In some cases, the lesion of the arm may not be recognized at all, or is thought to be metastatic from the breast carcinoma. Differential diagnosis includes chronic infection, trauma with ecchymoses, Kaposi's sarcoma, angiosarcoma, skin metastasis from breast carcinoma, and direct extension of breast carcinoma.

Twelve cases were treated by radical operation and 8 by radical radiotherapy. The results were better

than with local amputation or local excision. There was one five-year survival in the 20 cases. This followed radiotherapy. The latter procedure has the advantage of preserving the limb.

One photomicrograph; 3 photographs; 3 tables.

EUGENE A. CORNELIUS, M.D.
Houston, Texas

Measurements of Superficial Absorbed Dose with 2 Mv X Rays Used at Glancing Angles. H. A. Hughes. Brit. J. Radiol. **32:** 255–258, April 1959. (Windscale Works, Sellafield, Seascale, Cumberland, England)

The suitability of a high-energy x-ray beam for treatment of sites involving superficial tissue is governed by the rate of build-up of absorbed dose. This problem arises in the use of such a beam for tangential irradiation of the chest in the treatment of mammary carcinoma, where a high depth dose and low differential energy absorption between bone and soft tissue are particularly helpful, but where a normally advantageous slow build-up and low surface ionization ratio might prejudice the adequate treatment of involved superficial tissue. This latter possibility can be overcome by added build-up material, but for technical reasons the thickness of this material would necessarily be such as to produce complete build-up on the skin and any chance of reducing skin reaction would be lost.

From a study of the build-up curves at normal incidence for a 10 × 15-sq. cm. field from a 2-Mv Van de Graaff x-ray machine and a 4-Mv linear accelerator, it appears that the rate of build-up from the 2-Mv beam is possibly sufficient to warrant its use without added material in the above-mentioned treatment, whereas the 4-Mv beam is unlikely to fulfill the necessary conditions. An investigation of build-up occurring in the type of situation arising from the proposed treatment was made to verify this possibility.

The author describes a photographic film method of investigating the variation of absorbed dose near an air-tissue interface, which involves the use of a microdensitometer. The depth at which complete build-up occurs is rather difficult to judge because of the slow rate of rise toward the equilibrium depth. A better defined point is that at which 80 per cent of the maximum absorbed dose is reached; this value may also be of clinical significance when considering the treatment of diseased tissue. The measured depths of the film may be converted approximately into depths normal to the surface by multiplying by $\sin \theta$.

Application of the method to a situation in which the angle of incidence of the x-ray beam varies from 0 to 180° shows that at 2 Mv the 80 per cent depth varies from 0.15 to 1.1 mm. below the surface. It is suggested that this allows adequate treatment of superficial tissue, while retaining some degree of skin saving even when the angle of incidence to the normal is 90°.

Seven figures.

RADIOISOTOPES

Radioactive Phosphorus in the Treatment of Chronic Leukemias: Long-Term Results Over a Period of 15 Years. Edward H. Reinhard, Charles L. Neely, and Don M. Samples. Ann. Int. Med. **50:** 942–958, April 1959. (Washington University School of Medicine, St. Louis, Mo.)

The paper reports long-term results and survival data on a series of patients with chronic leukemia whose treatment was solely or predominantly with radioactive phosphorus. The series includes 102 cases of chronic lymphocytic leukemia and 118 cases of chronic granulocytic leukemia. All patients were seen and treated between 1942 and 1953 and for those selected for this report, the follow-up period and data are considered adequate for assessment. Many of these patients received other treatment, usually roentgen therapy and/or blood transfusions, but in each case P^{32} was the mainstay in management.

A few notes regarding details of therapy indicate that treatment was based on symptoms and physical signs rather than purely on blood counts and was given without regard to the stage of the disease, whether early or terminal. P^{32} was administered intravenously in all instances, in doses from 1 to 2.5 mc. Injections were ordinarily given approximately two weeks apart; a "course of treatment" usually consisted of 6 to 12 mc of P^{32}. For chronic lymphocytic leukemia the average patient received about 12 mc, but with a wide dosage range, from 3 to 55 mc total. In chronic granulocytic leukemia the average total dose was 22 mc, with a range between 3 and 84 mc.

An analysis of the effects of P^{32} on organ enlargement is made. The response reported represents the maximal improvement observed during the course of therapy, usually at an arbitrary period, six weeks after completion of the initial series of P^{32} injections. In the case of lymph node enlargement, approximately one-half of the patients in each disease group showed marked decrease in the size of involved nodes. Effect on splenic enlargement was similar, with demonstration of about 50 per cent decrease in projection of the spleen below the costal margin for each disease. Findings in hepatomegaly were about the same.

Interesting observations regarding the effects of P^{32} therapy on anemia are reported. Only two of 23 anemic, nontransfused patients suffering from chronic lymphocytic leukemia showed an increase of 2 gm. or more in hemoglobin levels following therapy. On the other hand, 22 of 46 similar patients with chronic granulocytic leukemia showed definite improvement in hemoglobin levels. Parallel findings were shown for platelet counts, namely, no improvement with lymphocytic leukemia and a favorable response in granulocytic disease.

A complex discussion of statistical methods of reporting survival rates is given, with multiple tables and graphs. Calculated five-year survival rates were 51 per cent for lymphocytic leukemia and only 12.5 per cent for granulocytic disease. Methods of arriving at these conclusions are presented and discussed.

A review of the causes of death is made on the basis of postmortem examinations where possible and available clinical evidence in other instances. One hundred eighty-nine patients suffering from both diseases were available for study. Death was due directly to leukemia or to severe infection or to hemorrhage in two-thirds of the patients with chronic lymphocytic leukemia and in three-fourths of those with granulocytic disease.

Other serious disorders producing death are presented in a table.

This analysis is made for the purpose of affording pertinent information in evaluating the course and response of chronic leukemia to radioactive phosphorus therapy. The authors recognize that both of these diseases may now be perhaps better managed with chemotherapy or combined methods.

Six graphs; 8 tables. JAMES W. BARBER, M.D. Cheyenne, Wyo.

The Uptake of P^{32} as a Measure of Cellular Metabolism in the Human Thyroid. Colin G. Thomas, Jr., and Ethel A. Wilson. J. Clin. Endocrinol. **19:** 306–316, March 1959. (North Carolina Memorial Hospital, Chapel Hill, N. C.)

The purpose of the investigation reported here was to establish a noniodine parameter of cell metabolism in the human thyroid, namely, the incorporation of radiophosphorus. P^{32} was administered intravenously twenty-four hours before operation to patients undergoing surgical treatment of diffuse toxic goiter, toxic nodular goiter, nodular goiter, or carcinoma of the thyroid. Control studies were made on a group of euthyroid patients undergoing operations unrelated to the thyroid.

At the time of surgery, representative specimens were procured from the thyroid, muscle, and blood. The ratio of counts per minute per milligram of thyroid to counts per minute per 0.001 milliliter of serum was thought to be the most reliable index of P^{32} content. Representative "thyroid-serum ratios" were as follows: normal thyroid, 23; Graves' disease treated with propylthiouracil and Lugol's solution, 33; Graves' disease treated with propylthiouracil alone, 49; follicular adenoma, 20; fetal adenoma, 40; carcinoma of the thyroid, 71. Administration of propylthiouracil and Lugol's solution to patients with hyperthyroidism seemed to have little demonstrable effect upon the total incorporation of P^{32}. Neither was P^{32} uptake decreased in patients with suppressed hormone synthesis due to inhibition of TSH by *l*-triiodothyronine or desiccated thyroid.

It is concluded from these studies in man that total phosphorus content, as determined by radioactivity twenty-four hours after administration of P^{32}, is related primarily to the density of the cell (probably reflecting nucleoprotein content) rather than to functional activity of the cell (hormone synthesis). The lack of suppression of P^{32} uptake, particularly by agents known to suppress stimulation by thyrotropin and formation of thyroid hormone, suggests an autonomy on the part of the cell that is somewhat greater than realized.

Fifteen photomicrographs; 1 table.

Study of Revascularization of Autogenous Cortical Bone Grafts in Rabbit Using Radiophosphorus. Albert B. Ferguson, Jr., Patrick G. Laing, Mary Grebner, and Laverne Madancy. Arch. Surg. **78:** 551–555, April 1959. (Children's Hospital, Pittsburgh, Penna.)

More than 250 bone graft operations were performed on the tibias of over 150 rabbits. The grafts were cut from the subcutaneous cortical surface of the upper tibial metaphyses and were replaced in the same defect on the same side. Some were cut with electric saws and some with osteotomes. Some were kept solid, while others were chopped into small pieces. Some of the grafts were stripped of the fibrous layers of the periosteum. At weekly intervals after surgery, groups of animals were given P^{32} and killed ninety minutes later. P^{32}-activity determinations were then done on the grafts.

The chopped grafts showed more rapid revascularization than the solid grafts, probably because of the large total surface area. Those cut with the saw showed a delay in vascularization but in the fourth week some showed even higher P^{32} activity than those cut with the osteotome. The authors conclude that cutting with the saw leaves a barrier of necrotic bone to be absorbed first but this, by acting as a foreign body, causes an increase in local vascularity.

The grafts with all layers of periosteum carefully preserved showed slower vascularization than grafts stripped of periosteum. The authors point out that the active layer is not removed by stripping and that the fibrous layers merely present a barrier to the growth of new vessels.

Two graphs. ZAC F. ENDRESS, M.D. Pontiac, Mich.

Assay of Thyroid Function in Diabetes Mellitus. John H. Felts, I. Meschan, and T. H. Oddie. J. Clin. Endocrinol. **19:** 330–333, March 1959. (Bowman Gray School of Medicine, Winston-Salem, N.C.)

Thyroid function was assayed in 25 unselected patients with diabetes mellitus by measuring thyroidal and renal clearance rates of radioiodine (I^{131}). The thyroidal clearance rate of radioiodine was within the normal range in all patients; the renal clearance rate was markedly decreased in patients with intercapillary glomerulosclerosis but was within normal limits in the other diabetic subjects, including 2 with retinopathy without nephropathy. This indicates that thyroidal handling of iodine is normal in all phases of diabetes mellitus and that altered urinary excretion patterns are a reflection of the renal lesion rather than of the underlying systemic disease.

One table. AUTHORS' SUMMARY

Effect of Meprobamate-Tridihexethyl Iodide on the Uptake of Radioactive Iodine and on the Serum Protein-Bound Iodine. Stanley Slater and Marvin Numeroff. New England J. Med. **259:** 974–975, Nov. 13, 1958. (Maimonides Hospital, Brooklyn 19, N. Y.)

The administration to a patient of substances containing iodine may result in spurious alterations of the thyroidal uptake of radioactive iodine and the level of serum protein-bound iodine. When it was noted that a preparation of meprobamate with an anticholinergic drug contained iodine, the authors undertook to determine the effect, if any, of ingestion of this preparation on the protein-bound iodine and the iodine uptake of 10 euthyroid subjects.

Control determinations of the twenty-four-hour uptake of I^{131} by the thyroid gland and of the serum protein-bound iodine were made, after which the patient ingested 2 to 4 tablets of Milpath daily, each tablet containing 400 mg. of meprobamate and 25 mg. of tridihexethyl iodide. After the tablets had been taken for five to fourteen days, the determinations were repeated. In some patients, only the protein-bound iodine was measured. The administration of the above preparation was found to cause a suppression of the thyroid uptake of radioactive iodine to abnormally low levels. There was no concomitant change in the levels of serum protein-bound iodine. It is not known

whether the meprobamate or the tridihexethyl iodine is responsible for the effect observed, or whether the combination is necessary.

Radioactive Zinc in the Prostate: Some Factors Influencing Concentrations in Dogs and Men. George R. Prout, Jr., Michael Sierp, and Willet F. Whitmore, Jr. J.A.M.A. **169:** 1703–1710, April 11, 1959. (M. S., Memorial Center for Cancer and Allied Diseases, New York, N. Y.)

Concentrations of radioactive zinc in the prostate and prostatic fluid of dogs were investigated in a group of 6 animals in which prostatic fistulas had been created surgically. The ability of the canine prostate to concentrate and secrete zinc, reported by others, is further corroborated by these studies. Suitable procedures demonstrated decreased amounts of zinc storage following orchiectomy and gently increased amounts after administration of testosterone.

Related studies were possible in man by the injection preoperatively of 100 to 150 microcuries of zinc 65 intravenously and subsequent examination of normal and abnormal prostatic tissue removed at surgery. It was again found that the normal prostate contained more radioactive zinc than did any other normal tissues biopsied and studied. Neoplastic prostatic tissue contained less zinc than normal prostatic tissue and apparently less than tissue from benign hyperplasia.

Information thus far available regarding concentrations of radioactive zinc in the genitalia of mammals seems to indicate that the propensity for radioactive zinc concentration by the prostate is an androgen-controlled phenomenon affected adversely by either orchiectomy or by administration of female hormones. These studies are fairly conclusive for the dog but need further elucidation in man. The basic major question regarding the function of zinc in the genital tract remains unanswered.

Detailed descriptions of the experiments are given.

Four charts; 8 tables. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Transcranial Yttrium^{90} Hypophysectomy. Joseph P. Evans, Wolfgang Fenge, William A. Kelly, and Paul V. Harper, Jr. Surg., Gynec. & Obst. **108:** 393–405, April 1959. (Argonne Cancer Research Hospital, Chicago, Ill.)

Hypophysectomy is believed to play a role in the alleviation or arrest of some neoplasms which arise in glandular tissues endocrinologically dependent on the pituitary. The authors believe that the only tumors which are hormonally dependent are those arising in the breast or prostate.

Insertion of yttrium-90 pellets into the hypophysis *via* a transcranial approach is believed to approximate surgical hypophysectomy in safety and effectiveness. A transsphenoidal approach is now being used and has proved to be a simpler procedure. It seems probable that total destruction of the gland is not imperative for a favorable response.

In reporting their results, the authors define *arrest* to mean "a subjective relief of pain and objective evidence of a stationary situation as evidenced in local appearance of the breast lesion, stationary x-ray appearance of metastases, and arrest of pleural effusion." By *regression* is meant "subjective relief of pain, objective evidence of recession in the local breast lesion, improved x-ray appearance of metastases, and arrest of pleural effusion."

In 31 cases of carcinoma of the female breast, yttrium-90 transcranial hypophysectomy was followed by an arrest of the disease in 8 cases. The arrests have been of twelve or more months duration. In 3 cases a regression of the disease process had persisted, at the time of this report, for thirteen or more months. The authors know of no way of predicting which patients with female breast cancers will respond favorably.

The mortality for 45 operations with the intention of placing radioactive pellets in the hypophysis was 18.1 per cent. Results were negative in all types of tumors other than those of breast or prostate.

Four roentgenograms; 2 photomicrographs; 1 photograph; 5 tables. MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Radioarsenic in Plasma, Urine, Normal Tissues, and Intracranial Neoplasms. Distribution and Turnover After Intravenous Injection in Man. John Mealey, Jr., Gordon L. Brownell, and William H. Sweet. Arch. Neurol. & Psychiat. **81:** 310–320, March 1959. (Massachusetts General Hospital, Boston, Mass.)

During the evolution of brain-tumor localization by means of positron-emitting radioactive isotopes over the past four years, a large amount of data on the behavior of inorganic arsenic in man has been accumulated (see, for example, Sweet and Brownell: J.A.M.A. **157:** 1183, 1955. Abst. in Radiology **66:** 289, 1956). The present paper has to do with experimentally determined distribution and turnover of radioarsenic (As^{74}) in normal tissues, as well as in various intracranial neoplasms from over 100 patients.

The authors summarize their observations as follows:

"Concentrations of As^{74} serially assayed in the plasma subsequent to administration of labeled arsenite reflect the complex metabolism of the ion. The concentration curve may be represented as a sum of the three exponential components, the last representing rate of excretion from a tenaciously held small residual pool of arsenic. Activity in the urine is found as both the arsenate and the arsenite.

"Serial assays of arsenic concentrations in 149 samples of specific tumor types relative to those of 140 samples of normal human brain have been plotted. Maximal concentrations and optimal ratios in general occur early. The order of decreasing tumor/brain ratios is meningiomas, glioblastomas, metastatic tumors, and astrocytomas.

"Radioarsenic (As^{74}) is found in all body tissues studied, as determined in 11 patients at autopsies from one hour to seventy-one days after intravenous injection of the isotope. The highest concentrations were in liver and kidney. On the basis of these data, radiation dosage to various tissues resulting from the administration of As^{74} in diagnostic scanning is calculated; it is compared with that incident to other radiographic diagnostic procedures."

Nine figures. WYNTON H. CARROLL, M.D.
Shreveport, La.

Distribution of Abnormal Hemoglobins in Puerto Rico and Survival Studies of Red Blood Cells Using Cr^{51}. Ramon M. Suarez, Roberto Buso, Leo M. Meyer, and S. T. Olavarrieta. Blood **14:** 255–261, March 1959. (Mimiya Hospital, Santurce, Puerto Rico)

A survey of the incidence of abnormal hemoglobin

in different racial groups distributed over the island of Puerto Rico was performed and the relation of the rate of destruction of red cells to the presence of abnormal hemoglobin patterns in the affected population was studied. The abnormal hemoglobins were classified by the difference in paper electrophoretic mobility. Fetal hemoglobin was measured by its resistance to alkaline denaturation. The red cell life span was determined by measuring the survival of erythrocytes labeled with radioactive sodium chromate. A total of 2,089 inhabitants were studied, of whom 602 were Negroes.

Forty-two persons were found to have abnormal hemoglobin. All but one of these were Negroes or Negroid of African descent, and their relative numbers agreed closely with the geographical distribution of ethnic groups in the island. Abnormal hemoglobins were found in 2.01 per cent of the entire series of 2,089 persons, but in those considered Negroes or Negroid the incidence was 6.8 per cent.

Of the 42 persons showing abnormal hemoglobin, 34 (81 per cent) had hemoglobin S, but only 2 of these had sickle-cell anemia. The incidence of the sickle-cell trait among the Puerto Rican Negro population was 5.2 per cent; and the incidence of hemoglobin S disease among those harboring the trait was 5.9 per cent. Eight, or 19 per cent, of the abnormal cases showed hemoglobin C; only one of these had hemoglobin C disease with clinical hemolytic anemia. The incidence of the hemoglobin C trait among the Puerto Rican Negro population is 1.3 per cent; and the incidence of hemoglobin C disease among those harboring the trait may reach 12.5 per cent.

All 42 cases harboring abnormal hemoglobins showed very small quantities of fetal or alkali-resistant hemoglobin, ranging from 0.45 per cent to 3.25 per cent, averaging 1.12 per cent. The "apparent" half-life of the red blood cells was found to be ten days in sickle-cell anemia, seven days in SC disease, 20.6 days in cases of hemoglobin SA, 18.5 days in one case of hemoglobin C disease, and 21.5 days in 2 cases of the combination CA. The normal "apparent" half-life in the authors' laboratory is 24.5 days.

One figure; 4 tables.

WYNTON H. CARROLL, M.D.
Shreveport, La.

An Autoradiographic Study of Tumor Dynamics. James C. Reid and Julius White. J. Nat. Cancer Inst. **22:** 845–867, April 1959. (National Cancer Institute, Bethesda, Md.)

In this communication the authors describe an attempt to visualize some of the dynamic factors of tumor growth by autoradiography. The experimental procedure consisted essentially of administering a single dose of a radioactive amino acid to a tumor-bearing host, subsequently killing the animal, slicing the tumor in half, and preparing an autoradiograph from the cut face. Two amino acids were used: glycine-*l*-C^{14} and L-lysine-U-C^{14}.

The authors make three significant points.

(1) There were no gradients of isotope concentration in the viable tissue from seven hours to two weeks after administration of the amino acid. (2) Necrotic tissue did not fix the isotope, and labeled tissue after becoming necrotic released isotope slowly. (3) The observations suggest that peripheral growth is not of particular significance in the propagation of tumors.

The level of radioactivity correlated with the tumor types is nicely summarized in a chart, with data on the various tumors. The five plates with 36 illustrations corroborate the authors' findings.

SYDNEY F. THOMAS, M.D.
Palo Alto, Calif.

Protection in Cobalt-60 and Cesium-137 Radiotherapy. Ruherí Pérez Tamayo. Rev. mex. de radiol. **13:** 61–80, March-April 1959. (In Spanish)

This is not an original article, but rather is a statement of internationally accepted norms of protection, which evidently have not previously been published in Spanish.

Included are a list of definitions; sections on general rules, basic principles for protection, protection barriers, radiation sources, teletherapy apparatus; and many graphs and tables derived from the National Bureau of Standards handbooks, recommendations of the International Commission on Radiation Protection, and other sources.

Twelve figures; 10 tables.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

RADIATION EFFECTS

Malignant Irradiation for Benign Conditions. Bradford Cannon, Judson G. Randolph, and Joseph E. Murray. New England J. Med. **260:** 197–202, Jan. 29, 1959. (B. C., Massachusetts General Hospital, Boston 14, Mass.)

The purpose of this paper is to document some of the disabling and life-endangering consequences of the use of irradiation in the treatment of benign conditions. A total of 165 cases from the records of the Massachusetts General Hospital and from personal files have been reviewed. A number of these have previously been reported by Daland (Surg., Gynec. & Obst. **72:** 32, 1941. Abst. in Radiology **38:** 258, 1942). In every case the irradiation was administered accidentally or for a benign lesion. In each, surgical treatment was performed or recommended for the damaged tissues. The chief complaint of nearly half the patients was persistent ulceration. In a fourth of the cases pain was the chief symptom, being promptly relieved by excision of the painful area. Twenty-one patients, or one-eighth of the total, sought aid for cosmetic reasons.

Twenty-eight of the series were professional workers. Sixteen were physicians; some were radiologists, orthopedic surgeons, and general physicians exposed in the first score of years after the discovery of the x-ray. Those exposed more recently appeared indifferent to the known dangers of irradiation.

Thirty-two patients had received irradiation for *plantar wart*. Surgery was indicated for the irreversible changes in the foot, not for recurrence of the wart. Most of these patients had had multiple treatments with x-rays; the average time lapse from exposure to surgical treatment was five and a half years. Nineteen patients with *abnormal skin conditions* (eczema, psoriasis, lichen planus, etc.) treated with x-rays had

severely injured skin and soft tissue. The mean latent period between skin exposure and skin breakdown in this group was fourteen years. Isolated *hemangiomas* given a small dose or doses of x-rays in infancy accounted for 14 cases. The average time lapse before the patients sought surgical advice was twenty years. Twelve cases of tissue damage followed the use of x-rays for *removal of unsightly hair*.

The sequelae of irradiation for *acne* seemed particularly deplorable. In 9 of 10 cases observed, cancer developed. A considerable number of other patients seeking treatment for unsightly acne scars gave a history of x-ray therapy to the face but, since no surgery was recommended, they are not included in this report. In some of these cases neoplastic changes can be anticipated. There was, in addition, an odd assortment of diseases treated by x-rays in sufficient dosage to produce severe skin damage; these include Dupuytren's contracture, pruritus, pulmonary tuberculosis, goiter, rheumatism, spondylitis, furuncle, gallbladder colic, and cervical adenitis.

Cancer was found in 36 of the 165 cases (22 per cent). The interval between x-ray exposure and the establishment of the diagnosis of cancer ranged from five to fifty years. In 5 cases the interval was over forty years. The average was twenty-eight years. This observation emphasizes the slow but relentless progression to malignant change that can be predicted in a significant number of those more recently exposed. Only by the prophylactic excision of *all* severely injured skin can the malignant transition be avoided. The prophylactic treatment of leukoplakia and colonic polyps is analogous. Fourteen of the 36 cancers were of the basal-cell type. This is contrary to the accepted teaching that only epidermoid carcinoma is found in irradiated areas. With one exception, all basal-cell lesions occurred on the face.

Seventy-six of the 165 patients were presumably cured after one surgical procedure. An additional 15 had required a second excision. The remainder have needed multiple operations, with extensive reconstructive procedures and other forms of surgery.

Evidence gained from this investigation and the work of others suggests that those not fully qualified in the therapeutic use of x-rays be excluded from the application of this potentially dangerous tool.

Ten photographs; 1 graph; 3 tables.

Acute Leukaemia Following Radioiodine Therapy of Thyrotoxicosis. H. Vetter and R. Höfer. Brit. J. Radiol. **32**: 263–264, April 1959. (Second Medical University Clinic, Vienna, Austria)

Leukaemia Following Irradiation in Utero. A. G. S. Cooper and A. W. Steinbeck. Brit. J. Radiol. **32**: 265, April 1959. (Brisbane Hospital, Brisbane, Australia)

Leukaemia Following Irradiation for Ankylosing Spondylitis. A. G. S. Cooper and A. W. Steinbeck. Brit. J. Radiol. **32**: 266–268, April 1959. (Brisbane Hospital, Brisbane, Australia)

1. The first of these 3 case reports deals with a 50-year-old male patient with acute leukemia developing about eighteen months after radioiodine therapy for thyrotoxicosis. This is apparently the sixth such case to be recorded. The patient received 7.1 mc of I^{131}, and the radiation dose was estimated at between 5,500 and 7,000 rads to the thyroid, and between 6 and 10 rads to the whole body.

It would seem that by chance alone one might expect 6 cases of leukemia in the large number of persons throughout the world who have been treated for thyrotoxicosis with I^{131}. However, since in every instance the latent period between radioiodine therapy and the onset of leukemia has been the same (eighteen months), the authors feel that the association is not merely fortuitous and that the therapy was relevant to the subsequent disease.

2. The second report tells of a patient who received scattered radiation *in utero* and was found to have acute leukemia at the age of three. Treatment was given to the mother during the fourth month of pregnancy for painful splenomegaly associated with polycythemia. About 750 r was given over the spleen in two weeks, through a single 10 × 15-cm. anterior port.

The leukemia was an undifferentiated-blast type, an uncommon form after irradiation, but the authors believe it "reasonable to accept a causal relationship."

3. The subject of the third report, a 53-year-old man, had leukemia following irradiation for ankylosing spondylitis. He had been given x-ray therapy totaling about 2,000 r to the cervicodorsal spine and about 3,000 r to the thoracic spine over a five-year period. Seven years after the last treatment an undifferentiated-blast type leukemia developed. Although the latent period before onset of leukemia was long, the writers feel that it is reasonable to presume a relationship with the antecedent radiotherapy.

Three tables. DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Adult Leukaemia. Trends in Mortality in Relation to Aetiology. W. M. Court Brown and R. Doll. Brit. M. J. **1**: 1063–1069, April 25, 1959. (W. M. C. B., Western General Hospital, Edinburgh, Scotland)

The deaths from leukemia in England and Wales for the period 1945 to 1957 were classified under three headings: acute leukemia of all types, chronic myeloid leukemia, and chronic lymphatic leukemia. The age-specific mortality rates were calculated for each type of leukemia for each sex, and for three periods of time—1945 to 1949, 1950 to 1954, and 1955 to 1957. For each of the three periods studied and for each of the three different classes of leukemia, there was found an appreciable increase in mortality with age during a large part of adult life. There was, however, an important difference in the trends of the mortality rates with time. In each age group the mortality of acute leukemia increased between 1945 and 1957, whereas the mortality from the chronic leukemias, with the exception of chronic myeloid leukemia in men, increased during the period of observation only in the older age groups. At these ages the mortality increased for all types of leukemia in both sexes, but the increase in chronic lymphatic leukemia in men was outstanding. The authors suggest that the observed increase in age-specific death rates of acute leukemia at ages under sixty years is largely real and due to increasing exposure of the population to leukemogenic factors in the environment, but that most of the increase in the death rate from the chronic leukemias is due to their better recognition consequent upon improved medical care for the elderly.

It is pointed out that evidence exists that radiation exposure has more often been associated with an increase in acute leukemia than in chronic myeloid leukemia, and not at all with an increase in chronic lymph-

atic leukemia. Of 50 cases occurring to date in an irradiated spondylitis series, inclusive of 41 cases reported by Court Brown and Doll (1957), no fewer than 38 have been examples of acute leukemia and only 8 chronic forms have been found. Only 1 of the 8 chronic leukemias was lymphatic in type.

"The extent to which the increases in the national mortality rate from acute leukemia may be related to increases in the artificial radiation background can be adequately assessed only with greater knowledge of the basic mechanisms of cancer induction and of the relationship between radiation dose and incidence. If, however, a leukemic process can be initiated not only by a gene mutation but also, and possibly more frequently, by a complex genetic disturbance depending on gross chromosome damage, then the more important physical factor may be the rate at which a radiation dose is given rather than the total dose. In this case it could be important that radiation for medical purposes is given at high dose rates in the approximate range of 40 to 100 r a minute, while the average dose rate from natural background radiation is 2×10^{-6} r a minute."

Five graphs; 5 tables.

The Influence of X Irradiation on the Iodide-Trapping Mechanism of the Human Parotid Gland. Hassan K. Awwad. Brit. J. Radiol. **32**: 259–262, April 1959. (Alexandria University, U. A. R. (Egypt))

This report concerns a somewhat roundabout effort to reveal the mode of action of ionizing irradiation on thyroid function. Both the thyroid and the salivary glands have an iodide trapping mechanism, but there is no organic binding in the salivary glands. It has been felt that it would be useful, therefore, to know what effect, if any, x-rays might have on the iodide trapping function of the parotid.

A group of 20 patients receiving therapeutic irradiation which would include one or both parotid glands was studied. Carrier-free radioactive iodine was given to each and x-ray doses up to 3,500 r in thirty-two days were then given to one or both parotid glands. It was found that although the amount of saliva dropped after treatment, the amount of radioiodine secretion was not affected. Apparently the iodide-trapping mechanism of the parotid is able to resist the immediate effects of the x-ray doses delivered.

The author suggests that experiments on the effect of x-irradiation on the iodide trapping phase of the iodine cycle in the thyroid gland is worth considering.

Two tables. DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Changes of the Vertebral Column and Pelvic Bones Following Irradiation in Childhood. Jaromír Kolár. Strahlentherapie **108**: 574–580, April 1959. (In German) (Radiologische Klinik, Karls-Universität, Prague, Czechoslovakia)

Stunted growth of the bones of the long extremities is known to occur following irradiation. Almost unknown, however, is dwarfing of the spine and pelvis after radiation therapy of the abdomen and thorax. This is understandable, since most children irradiated for malignant masses fail to live long enough for the development of growth damage.

Six cases are reported here, illustrating irradiation changes in the spine and pelvis. In the first case nephrectomy was performed for a nephroblastoma at ten months of age. Postoperative high-voltage roentgen therapy was given for a total dose of 2,360 r. Ten years later the child appeared healthy except for hypoplasia of the right hemipelvis and growth disturbance of the lumbar spine.

In the second case removal of the Wilms' tumor at the age of twenty-one months was followed by a radiation dose of 8,500 r. Thirteen years later the patient had a right convex scoliosis of the lumbar spine and 2-cm. shortening of the left leg. Bone changes were far advanced.

In the third case, 4,000 r were administered following removal of a Wilms' tumor at three years of age. Five years later the patient presented bone changes similar to those of the first case.

The fourth patient had an hemangioma of the back treated locally by radium at two years of age. Severe skin damage followed, and fifteen years later there was a marked kyphoscoliosis of the thoracic spine, with wedging and biconvex deformity of the vertebral bodies.

In the fifth case a fibromyxosarcoma of the left lumbar and gluteal region in a child of eight years was treated by high-voltage roentgen rays for a total of 4,000 r. Follow-up studies fifteen years later revealed hypoplasia of the left hemipelvis including the sacrum.

The sixth patient received a total dose of 4,500 r to the left lumbar region at three years of age for a fusiform sarcoma. Fifteen years later moderate dwarfing of the left hemipelvis was noted.

The author claims that most pronounced bone changes are bound to develop when radiation is applied within the first two years of life with a total dose of at least 2,000 r. The principal findings are structural transformation of bone architecture, with honeycombing and growth arrest lines. An irregular contour of the vertebral bodies, with notching, simulates chondrodystrophy. Secondary scoliosis is due to unilateral hypoplasia and wedging of the vertebrae. Retarded growth of a hemipelvis follows homolateral irradiation. Radiation myelitis occurs and is followed by damage to peripheral nerves with trophic disturbances. This is believed to be responsible for stunted growth of a lower extremity.

Nine roentgenograms. ERNEST KRAFT, M.D.
Northport, N. Y.

Irradiation Injury to the Aorta and the Lung. Elizabeth Thomas and Wiley D. Forbus. Arch. Path. **67**: 256–263, March 1959. (Duke University School of Medicine, Durham, N. C.)

The case of a 29-year-old man who died as a result of irradiation injury to the aorta and lungs is presented. The fact that damage to the lung may occur in the course of radiotherapy is well known, but the authors were unable to find any report of a clearly defined aortic injury directly attributable to irradiation. Their patient has been given three courses of deep x-ray therapy (the total dosage not accurately known) for a lymphomatous process of the mediastinum and neck (the specific diagnosis of which was uncertain), which had been discovered two and one-half years prior to death. At autopsy the thoracic aorta, both lungs, mediastinal lymph nodes, and sternal bone marrow showed pronounced changes due to irradiation. In the lungs and the aorta the injury produced was both necrotizing and stimulative. In the other tissues the effects were predominantly necrotizing and suppressive. The lung lesion was a peculiar form of chronic interstitial

necrosis, edema, and fibrosis, very similar to that described by other observers. The aortic lesion was a localized necrosis involving all layers of the vessel wall, accompanied by attempts at healing through proliferative changes in the connective tissue. The pulmonary injury was the predominant lethal factor. The aortic lesion, while potentially lethal, resulted in this instance in only the minor secondary complications of splenic and renal infarction from dislodged thrombi that had formed at the site of injury.

Two photographs; 5 photomicrographs.

Radiation Exposure of the Population of Mexico. Guillermo Santín. Rev. mex. de radiol. **13:** 43–60, March-April 1959. (In Spanish) (Coahuila 35, México 7, D. F.)

This is a general summary of the types, quantities, and effects of radiation to which the population of Mexico is exposed. It contains considerable statistical information on sources of radioactivity, genetic effects, safe doses for radioactive isotopes, amounts of exposure from diagnostic procedures, and so on, all familiar to most North American radiologists.

An interesting report is given on the amount of exposure from clocks and watches with luminous dial numbers, based upon autoradiographs, Geiger counter determinations, and Victoreen ionization chamber readings. The author's tables indicate that at the back of a wrist watch with permanently luminous characters, radiation is measurable in the amount of 0.25 mr/hour. This amounts to 2.18 r per year if the watch is worn twenty-four hours daily. On the watch face the exposure amounts to 9.98 r per year. An alarm clock delivers 1.2 mr per day at 50 cm. distance. An autoradiograph of a wrist watch through 4 mm. lead shows 42 mr exposure after fifteen days, pointing up the penetrating character of the radiation.

The author also gives an interesting speculative account of the origin of the earth, and the distribution of radioactive metals throughout the earth's crust. He then presents a verbal geologic map of the valley of Mexico, referring especially to occurrences of radioactive minerals. Background radiation records from numerous sites are tabulated.

The paper ends with another reminder that it is the obligation of society to keep radiation sources out of the hands of those not properly qualified to use them; that unnecessary exposures should be avoided; and that properly used radiation should not be feared.

Four figures; 13 tables.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Maximum Permissible Dietary Contamination After the Accidental Release of Radioactive Material from a Nuclear Reactor. Report to the Medical Research Council by Its Committee on Protection Against Ionizing Radiations. Brit. M. J. **1:** 967–969, April 11, 1959.

The British Medical Research Council's Committee on Protection against ionizing radiations has considered the problem of intake of radioactively contaminated foods, and has attempted to evaluate the hazards involved and to specify maximum permissible intake dosages. In formulating its recommendations, the Committee has utilized data published by others as well as information gathered from its own studies. It is stressed that the dosages proposed are tentative and may have to be modified as the knowledge of metabolism of radioisotopes expands. The Committee's recommended levels are thought to be on the conservative or cautious side.

The Committee's recommendations are stated in terms of maximum permissible daily intake of each of the discussed radioisotopes at various ages and take into account the metabolism of each element and the period during which the contamination of the food supply is likely to continue.

It is concluded that there are four important radioactive contaminating substances: iodine 131, producing its effect on the thyroid gland; strontium 90 and strontium 89, with effects on bone tissue; and cesium 137 with total-body irradiation effects. Since I^{131} and Sr^{90} irradiate different tissues in the body, the presence of both isotopes would not appreciably alter the accepted permissible dose of either. In the case of Cs^{137} the effect is total-body irradiation, so that if this element is present, permissible doses of any of the others would have to be decreased.

It is noted that the *permissible doses vary widely with the age of the individual* receiving the contaminated food. This is explained on the basis of differing metabolism at different ages. Fresh milk is the food most likely to be heavily contaminated by any of the discussed isotopes and, as expected, the greatest problem lies in infants and young children whose intake of milk is highest. Many accepted intake dosages are cited in the original article. A few of the important values quoted include the following.

(1) I^{131}: Proposed intake levels correspond to a *total* thyroid irradiation of 25 rad. Daily intake should be less than 60 mμc.

(2) Sr^{90}: Permissible intake corresponds to a total annual rate of 1.5 rad at the site of highest concentration in bone. Maximum daily intake 2 mμc.; half-life aproximately twenty-eight years.

(3) Sr^{89}: Total dose not to exceed 15 rad at the site of deposit. Maximum daily intake 200 mμC.; half-life fifty-three days.

(4) Cs^{37}: Total dose of 10 rad to the whole body. Daily intake not to exceed 60 mμc. in infants, 150 mμc. at ages after six months, and up to 1,150 mμc. in adults.

Other dietary intake levels that will produce the accepted maximum doses are cited in milli-microcuries per day at various ages. Comment is made as to how these values are determined and the reasons for selections of such permissible doses.

The article contains much basic dosage information which does not lend itself well to abstracting. The original communication should be consulted by those interested in this subject. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Reduction of Radiation Exposure in Diagnostic Examinations. Craig A. Horn. M. J. Australia **1:** 513–517, April 18, 1959. (Newcastle, N. S. W., Australia)

This paper is a rather sketchy account of factors and procedures for reducing radiation exposure in diagnostic procedures. The referring physician can help by correctly ordering the necessary films and the radiologist can contribute by himself taking a brief history and avoiding unnecessary examinations.

Masking or shielding of vulnerable tissues adjacent to the area to be studied, and various measures permit-

ting reduction of dose and of number of exposures are discussed, with particular attention to antenatal, pediatric, angiographic, and fluoroscopic procedures. Contrast studies of the gastrointestinal tract and casualty examinations are briefly considered.

Two roentgenograms; 4 photographs.

PAUL MASSIK, M.D.
Quincy, Mass.

The Effect of Total Body Irradiation on Bone Transplants in Parabiosed Animals. William F. Enneking and Avrum Gratch. J. Bone & Joint Surg. **41-A:** 463–474, April 1959. (University of Mississippi Medical Center, Jackson, Miss.)

It is known that large fresh homogenous bone transplants in rats evoke an inflammatory reaction in the host which usually causes sequestration of the transplant. If the transplant is repeated with the same animal as host, the tissue response evoked is more violent than on the first occasion. These observations indicate that there is an antibody reaction in the host circulation against the transplant. Other investigators have shown that total-body irradiation of animals improved the survival of homogenous skin transplants when irradiated animals were the hosts, presumably as a result of suppression of immunological response.

The authors' experiments were made to determine the effect of total-body irradiation upon the survival of homogenous bone transplants exchanged between surgically united rats. A total of 373 parabiotic unions were prepared, and of these 118 survived and were transplanted. The remainder died of several causes. In 99, deaths were due to parabiotic intoxication.

Before parabiosis, half of the rats received total-body irradiation. Union of the irradiated animals to unirradiated partners was performed forty-eight to seventy-two hours later and the irradiation was repeated every seventh day during the experiment, the other member of the union being shielded from radiation. Total irradiation was less than 60 per cent of the lethal dose. The transplants exchanged between the parabiotic pairs were full-circumference sections of the femoral shaft. These were later examined histologically.

The experiments showed that death from parabiotic intoxication occurred almost always in the irradiated animal. There was no detectable difference in healing of the clean surgical wounds produced by parabiosis or transplantation in the irradiated animals as compared to the nonirradiated. Bone preparations obtained prior to seven days after transplantation showed no difference in response between the two groups. After the seventh day findings were divergent. In 16 of the unions the irradiated rats showed no inflammatory response to the transplants, while the nonirradiated partners did. Twenty-eight pairs showed no adverse reaction to the transplants.

The authors conclude that total-body irradiation appears to be effective in blocking the rejection mechanism to large fresh homogenous bone transplants in surgically united rats.

Twenty figures, including 2 roentgenograms.

J. S. ARAJ, M.D.
Toledo, Ohio

Acute Effects of X-Radiation on Reflex Arcs of the Spinal Cord. K. Carrington, F. D. Fowler, and E. A. Bering, Jr. Neurology **9:** 251–255, April 1959. (Neurosurgical Research Laboratory of the Children's Medical Center, Boston)

Five thousand r of 250-kv roentgen radiation was given to the lumbar spinal cords of cats. Three animals were observed for clinical effect. Some early weakness was observed but completely disappeared in twenty-four hours. Complete paraplegia developed on the sixth or seventh day.

Seven cats were studied for electrophysiologic changes in spinal cord reflexes. Anterior root responses to posterior root stimulation before and immediately after irradiation were investigated. By the fifth hour after irradiation, response time became significantly delayed, indicating slower conduction rates. The total length of time of the response was not significantly changed until nine to ten hours after irradiation. The polysynaptic response gradually diminished in amplitude, and, eleven hours after irradiation, was almost absent. At this time the monosynaptic spike showed marked reduction in amplitude, but was always present as a simple spike. This later suggested cellular or synaptic alterations.

Three figures.

EUGENE A. CORNELIUS, M.D.
Houston, Texas